PART D

STANDARDS FOR PROTECTION AGAINST RADIATION

GENERAL PROVISIONS

1. Purpose.

A. Part D establishes standards for protection against ionizing radiation resulting from activities conducted pursuant to licenses or registrations issued by the Agency. These regulations are issued pursuant to the 22 MRSA, the Radiation Control Act.

B. The requirements of Part D are designed to control the receipt, possession, use, transfer, and disposal of sources of radiation by any licensee or registrant so the total dose to an individual, including doses resulting from all sources of radiation other than background radiation, does not exceed the standards for protection against radiation prescribed in Part D. However, nothing in Part D shall be construed as limiting actions that may be necessary to protect health and safety.

2. Scope. Except as specifically provided in other Parts of these regulations, Part D applies to persons licensed or registered by the Agency to receive, possess, use, transfer, or dispose of sources of radiation. The limits in Part D do not apply to doses due to background radiation, to exposure of patients to radiation for the purpose of medical diagnosis or therapy, to exposure from individuals administered radioactive material and released in accordance with Part G, or to voluntary participation in medical research programs.

3. Definitions. As used in this part, the following definitions apply:

Annual limit on intake (ALI) means the derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 0.05 Sv (5 rem) or a committed dose equivalent of 0.5 Sv (50 rem) to any individual organ or tissue. ALI values for intake by ingestion and by inhalation of selected radionuclides are given in Table I, Columns 1 and 2, of Appendix B.

Class means a classification scheme for inhaled material according to its rate of clearance from the pulmonary region of the lung. Materials are classified as D, W, or Y, which applies to a range of clearance half-times: for Class D, Days, of less than 10 days, for Class W, Weeks, from 10 to 100 days , and for Class Y, Years, of greater than 100 days. For purposes of these regulations, "lung class" and "inhalation class" are equivalent terms.

Declared pregnant woman means a woman who has voluntarily informed the licensee, in writing, of her pregnancy and the estimated date of conception The declaration remains in effect until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant.

Derived air concentration (DAC) means the concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work, results in an intake of one ALI. For purposes of these regulations, the condition of light work is an inhalation rate of 1.2 cubic meters of air per hour for 2,000 hours in a year. DAC values are given in Table I, Column 3, of Appendix B.

Derived air concentration-hour (DAC-hour) means the product of the concentration of radioactive material in air, expressed as a fraction or multiple of the derived air concentration for each radionuclide, and the time of exposure to that radionuclide, in hours. A licensee or registrant may take 2,000 DAC-hours to represent one ALI, equivalent to a committed effective dose equivalent of 0.05 Sv (5 rem).

Dosimetry processor means an individual or an organization that processes and evaluates individual monitoring devices in order to determine the radiation dose delivered to the monitoring devices.

Inhalation class [see "Class"].

Lung class [see "Class"].

Nonstochastic effect means a health effect, the severity of which varies with the dose and for which a threshold is believed to exist. Radiation- induced cataract formation is an example of a nonstochastic effect. For purposes of these regulations, "deterministic effect" is an equivalent term.

Planned special exposure means an infrequent exposure to radiation, separate from and in addition to the annual occupational dose limits.

Quarter means a period of time equal to one-fourth of the year observed by the licensee, approximately 13 consecutive weeks, providing that the beginning of the first quarter in a year coincides with the starting date of the year and that no day is omitted or duplicated in consecutive quarters.

Reference Man means a hypothetical aggregation of human physical and physiological characteristics determined by international consensus. These characteristics may be used by researchers and public health workers to standardize results of experiments and to relate biological insult to a common base. A description of the Reference Man is contained in the International Commission on Radiological Protection report, ICRP Publication 23, "Report of the Task Group on Reference Man."

Respiratory protection device means an apparatus, such as a respirator, used to reduce the individual's intake of airborne radioactive materials.

Sanitary sewerage means a system of public sewers for carrying off waste water and refuse, but excluding sewage treatment facilities, septic tanks, and leach fields owned or operated by the licensee or registrant.

Stochastic effect means a health effect that occurs randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of dose without threshold. Hereditary effects and cancer incidence are examples of stochastic effects. For purposes of these regulations, "probabilistic effect" is an equivalent term.

Very high radiation area means an area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving an absorbed dose in excess of 5 Gy (500 rads) in 1 hour at 1 meter from a source of radiation or 1 meter from any surface that the radiation penetrates.[1]/

[1]/ At very high doses received at high dose rates, units of absorbed dose, gray and rad, are appropriate, rather than units of dose equivalent, sievert and rem.

Weighting factor w_T for an organ or tissue (T) means the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly. For calculating the effective dose equivalent, the values of w_T are:

ORGAN DOSE WEIGHTING FACTORS

Organ/Tissue	**w_T**
Gonads	0.25
Breast	0.15
Red bone marrow	0.12
Lung	0.12
Thyroid	0.03
Bone surfaces	0.03
Remainder	0.30[a]
Whole Body	**1.00[b]**

a 0.30 results from 0.06 for each of 5 "remainder" organs, excluding the skin and the lens of the eye, that receive the highest doses.

b For the purpose of weighting the external whole body dose, for adding it to the internal dose, a single weighting factor, w_T = 1.0, has been specified. The use of other weighting factors for external exposure will be approved on a case-by-case basis until such time as specific guidance is issued.

4. Implementation.

A. Any existing license or registration condition that is more restrictive than Part D remains in force until there is an amendment or renewal of the license or registration.

B. If a license or registration condition exempts a licensee or registrant from a provision of Part D in effect on or before January 1, 1994, it also exempts the licensee or registrant from the corresponding provision of Part D.

C. If a license or registration condition cites provisions of Part D in effect prior to January 1, 1994, which do not correspond to any provisions of Part D, the license or registration condition remains in force until there is an amendment or renewal of the license or registration that modifies or removes this condition.

RADIATION PROTECTION PROGRAMS

5. Radiation Protection Programs.

A. Each licensee or registrant shall develop, document, and implement a radiation protection program sufficient to ensure compliance with the provisions of Part D. See D.41 for record keeping requirements relating to these programs.

B. The licensee or registrant shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and public doses that are as low as is reasonably achievable (ALARA).

C. The licensee or registrant shall periodically (at least annually), review the radiation protection program content and implementation.

D. To implement the ALARA requirements of D.5. B and notwithstanding the requirements in D.14, a constraint on air emissions of radioactive material to the environment, excluding Radon-222 and its daughters, shall be established by licensees other than those subject to 10 CFR Part 50.34a of the USNRC regulations, such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 0.1mSv (10 mrem) per year from these emissions. If a licensee subject to this requirement exceeds this dose constraint, the licensee shall report the exceedance as provided in D.53 and promptly take appropriate corrective action to ensure against recurrence.

OCCUPATIONAL DOSE LIMITS

6. Occupational Dose Limits for Adults.

A. The licensee or registrant shall control the occupational dose to individual adults, except for planned special exposures pursuant to D.11, to the following dose limits:

(1) An annual limit, which is the more limiting of:

a. The total effective dose equivalent being equal to 0.05 Sv (5 rem); or

b. The sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 0.5 Sv (50 rem).

(2) The annual limits to the lens of the eye, to the skin of the whole body, and to the skin of the extremities, which are:

a. A lens dose equivalent of 0.15 Sv (15 rem), and

b. A shallow dose equivalent of 0.5 Sv (50 rem) to the skin of the whole body or to the skin of any extremity.

B. Doses received in excess of the annual limits, including doses received during accidents, emergencies, and planned special exposures, shall be subtracted from the limits for planned special exposures that the individual may receive during the current year and during the individual's lifetime. See D.11.E.(1) and (2).

C. The assigned deep dose equivalent and shallow dose equivalent shall be for the portion of the body receiving the highest exposure determined as follows:

(1) The assigned shallow dose equivalent must be the dose averaged over the contiguous 10 square centimeters of skin receiving the highest exposure. The deep dose equivalent, lens dose equivalent and shallow dose equivalent may be assessed from surveys or other radiation measurements for the purpose of demonstrating compliance with the occupational dose limits, if the individual monitoring device was not in the region of highest potential exposure, or the results of individual monitoring are unavailable; or

(2) (*Reserved*.)

D. Derived air concentration (DAC) and annual limit on intake (ALI) values are presented in Table I of Appendix B and may be used to determine the individual's dose and to demonstrate compliance with the occupational dose limits. See D.46.

E. Notwithstanding the annual dose limits, the licensee shall limit the soluble uranium intake by an individual to 10 milligrams in a week in consideration of chemical toxicity. See footnote 3 of Appendix B.

F. The licensee or registrant shall reduce the dose that an individual may be allowed to receive in the current year by the amount of occupational dose received while employed by any other person. See D.10.E.

7. Compliance with Requirements for Summation of External and Internal Doses.

A. If the licensee or registrant is required to monitor pursuant to both D.18.A and B, the licensee or registrant shall demonstrate compliance with the dose limits by summing external and internal doses. If the licensee or registrant is required to monitor only pursuant to D.18.A or only pursuant to D.18.B, then summation is not required to demonstrate compliance with the dose limits. The licensee or registrant may demonstrate compliance with the requirements for summation of external and internal doses pursuant to D.7.B, C and D. The dose equivalents for the lens of the eye, the skin, and the extremities are not included in the summation, but are subject to separate limits.

B. Intake by Inhalation. If the only intake of radionuclides is by inhalation, the total effective dose equivalent limit is not exceeded if the sum of the deep dose equivalent divided by the total effective dose equivalent limit, and one of the following, does not exceed unity:

(1) The sum of the fractions of the inhalation ALI for each radionuclide, or

(2) The total number of derived air concentration-hours (DAC-hours) for all radionuclides divided by 2,000, or

(3) The sum of the calculated committed effective dose equivalents to all significantly irradiated organs or tissues (T) calculated from bioassay data using appropriate biological models and expressed as a fraction of the annual limit. For purposes of this requirement, an organ or tissue is deemed to be significantly irradiated if, for that organ or tissue, the product of the weighting factors, w_T, and the committed dose equivalent, $H_{T,50}$, per unit intake is greater than 10 percent of the maximum weighted value of $H_{T,50}$, that is, $w_T H_{T,50}$, per unit intake for any organ or tissue.

C. Intake by Oral Ingestion. If the occupationally exposed individual also receives an intake of radionuclides by oral ingestion greater than 10 percent of the applicable oral ALI, the licensee or registrant shall account for this intake and include it in demonstrating compliance with the limits.

D. Intake through Wounds or Absorption through Skin. The licensee or registrant shall evaluate and, to the extent practical, account for intakes through wounds or skin absorption. Note the intake through intact skin has been included in the calculation of DAC for hydrogen-3 and does not need to be further evaluated.

8. Determination of External Dose from Airborne Radioactive Material.

A. Licensees or registrants shall, when determining the dose from airborne radioactive material, include the contribution to the deep dose equivalent, lens dose equivalent, and shallow dose equivalent from external exposure to the radioactive cloud. See Appendix B, footnotes 1 and 2.

B. Airborne radioactivity measurements and DAC values shall not be used as the primary means to assess the deep dose equivalent when the airborne radioactive material includes radionuclides other than noble gases or if the cloud of airborne radioactive material is not relatively uniform. The determination of the deep dose equivalent to an individual shall be based upon measurements using instruments or individual monitoring devices.

9. Determination of Internal Exposure.

A. For purposes of assessing dose used to determine compliance with occupational dose equivalent limits, the licensee or registrant shall, when required pursuant to D.18, take suitable and timely measurements of:

(1) Concentrations of radioactive materials in air in work areas; or

(2) Quantities of radionuclides in the body; or

(3) Quantities of radionuclides excreted from the body; or

(4) Combinations of these measurements.

B. Unless respiratory protective equipment is used, as provided in D.24, or the assessment of intake is based on bioassays, the licensee or registrant shall assume that an individual inhales radioactive material at the airborne concentration in which the individual is present.

C. When specific information on the physical and biochemical properties of the radionuclides taken into the body or the behavior of the material in an individual is known, the licensee or registrant may:

(1) Use that information to calculate the committed effective dose equivalent, and, if used, the licensee or registrant shall document that information in the individual's record; and

(2) Upon prior approval of the Agency, adjust the DAC or ALI values to reflect the actual physical and chemical characteristics of airborne radioactive material, for example, aerosol size distribution or density; and

(3) Separately assess the contribution of fractional intakes of Class D, W, or Y compounds of a given radionuclide to the committed effective dose equivalent. See Appendix B.

D. If the licensee or registrant chooses to assess intakes of Class Y material using the measurements given in D.9.A.(2) or (3), the licensee or registrant may delay the recording and reporting of the assessments for periods up to 7 months, unless otherwise required by D.52 or D.53. This delay permits the licensee or registrant to make additional measurements basic to the assessments.

E. If the identity and concentration of each radionuclide in a mixture are known, the fraction of the DAC applicable to the mixture for use in calculating DAC-hours shall be either:

(1) The sum of the ratios of the concentration to the appropriate DAC value, that is, D, W, or Y, from Appendix B for each radionuclide in the mixture; or

(2) The ratio of the total concentration for all radionuclides in the mixture to the most restrictive DAC value for any radionuclide in the mixture.

F. If the identity of each radionuclide in a mixture is known, but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture shall be the most restrictive DAC of any radionuclide in the mixture.

G. When a mixture of radionuclides in air exists, a licensee or registrant may disregard certain radionuclides in the mixture if:

(1) The licensee or registrant uses the total activity of the mixture in demonstrating compliance with the dose limits in D.6 and in complying with the monitoring requirements in D.18.B, and

(2) The concentration of any radionuclide disregarded is less than 10 percent of its DAC, and

(4) The sum of these percentages for all of the radionuclides disregarded in the mixture does not exceed 30 percent.

H. When determining the committed effective dose equivalent, the following information may be considered:

(1) In order to calculate the committed effective dose equivalent, the licensee or registrant may assume that the inhalation of one ALI, or an exposure of 2,000 DAC-hours, results in a committed effective dose equivalent of 0.05 Sv (5 rem) for radionuclides that have their ALIs or DACs based on the committed effective dose equivalent.

(2) For an ALI and the associated DAC determined by the non-stochastic organ dose limit of 0.5 Sv (50 rem), the intake of radionuclides that would result in a committed effective dose equivalent of 0.05 Sv (5 rem), that is, the stochastic ALI, is listed in parentheses in Table I of Appendix B. The licensee or registrant may, as a simplifying assumption, use the stochastic ALI to determine committed effective dose equivalent. However, if the licensee or registrant uses the stochastic ALI, the licensee or registrant shall also demonstrate that the limit in D.6.A.(1)b. is met.

10. Determination of Prior Occupational Dose.

A. For each individual who is likely to receive, in a year, an occupational dose requiring monitoring pursuant to D.18, the licensee or registrant shall:

(1) Determine the occupational radiation dose received during the current year; and

(2) Attempt to obtain the records of cumulative occupational radiation dose.

B. Prior to permitting an individual to participate in a planned special exposure, the licensee or registrant shall determine:

(1) The internal and external doses from all previous planned special exposures; and

(2) All doses in excess of the limits, including doses received during accidents and emergencies, received during the lifetime of the individual; and

(3) All cumulative occupational radiation dose.

C. In complying with the requirements of D.10.A, a licensee or registrant may:

(1) Accept, as a record of the occupational dose that the individual received during the current year, a written signed statement from the individual, or from the individual's most recent employer for work involving radiation exposure, that discloses the nature and the amount of any occupational dose that the individual received during the current year; and

(2) Accept, as the record of cumulative radiation dose, an up-to-date HHE 835 or equivalent, signed by the individual and countersigned by an appropriate official of the most recent employer for work involving radiation exposure, or the individual's current employer, if the individual is not employed by the licensee or registrant; and

(3) Obtain reports of the individual's dose equivalent from the most recent employer for work involving radiation exposure, or the individual's current employer, if the individual is not employed by the licensee or registrant, by telephone, telegram, facsimile, or letter. The licensee or registrant shall request a written verification of the dose data if the authenticity of the transmitted report cannot be established.

D. The licensee or registrant shall record the exposure history, as required by D.10.A, on HHE 835, or other clear and legible record, of all the information required on that form. The form or record shall show each period in which the individual received occupational exposure to radiation or radioactive material and shall be signed by the individual who received the exposure.

(1) For each period for which the licensee or registrant obtains reports, the licensee or registrant shall use the dose shown in the report in preparing HHE 835 or equivalent. For any period in which the licensee or registrant does not obtain a report, the licensee or registrant shall place a notation on HHE 835 or equivalent indicating the periods of time for which data are not available.

(2) Licensees or registrants are not required to reevaluate the separate external dose equivalents and internal committed dose equivalents or intakes of radionuclides assessed pursuant to the regulations in Part D in effect before January 1, 1994. Further, occupational exposure histories obtained and recorded on HHE 835 or equivalent before January 1, 1994, would not have included effective dose equivalent, but may be used in the absence of specific information on the intake of radionuclides by the individual.

E. If the licensee or registrant is unable to obtain a complete record of an individual's current and previously accumulated occupational dose, the licensee or registrant shall assume:

(1) In establishing administrative controls pursuant to D.6.F. for the current year, that the allowable dose limit for the individual is reduced by 12.5 mSv (1.25 rem) for each quarter for which records were unavailable and the individual was engaged in activities that could have resulted in occupational radiation exposure; and

(2) That the individual is not available for planned special exposures.

F. The licensee or registrant shall retain the records on HHE 835 or equivalent until the Agency terminates each pertinent license or registration requiring this record. The licensee or registrant shall retain records used in preparing HHE 835 or equivalent for 3 years after the record is made.

11. Planned Special Exposures. A licensee or registrant may authorize an adult worker to receive doses in addition to and accounted for separately from the doses received under the limits specified in D.6 provided that each of the following conditions is satisfied:

A. The licensee or registrant authorizes a planned special exposure only in an exceptional situation when alternatives that might avoid the dose estimated to result from the planned special exposure are unavailable or impractical.

B. The licensee or registrant, and employer if the employer is not the licensee or registrant, specifically authorizes the planned special exposure, in writing, before the exposure occurs.

C. Before a planned special exposure, the licensee or registrant ensures that each individual involved is:

(1) Informed of the purpose of the planned operation; and

(2) Informed of the estimated doses and associated potential risks and specific radiation levels or other conditions that might be involved in performing the task; and

(3) Instructed in the measures to be taken to keep the dose ALARA considering other risks that may be present.

D. Prior to permitting an individual to participate in a planned special exposure, the licensee or registrant ascertains prior doses as required by D.10.B during the lifetime of the individual for each individual involved.

E. Subject to D.6.B, the licensee or registrant shall not authorize a planned special exposure that would cause an individual to receive a dose from all planned special exposures and all doses in excess of the limits to exceed:

(1) The numerical values of any of the dose limits in D.6.A in any year; and

(2) Five times the annual dose limits in D.6.A during the individual's lifetime.

F. The licensee or registrant maintains records of the conduct of a planned special exposure in accordance with D.45 and submits a written report in accordance with D.54.

G. The licensee or registrant records the best estimate of the dose resulting from the planned special exposure in the individual's record and informs the individual, in writing, of the dose within 30 days from the date of the planned special exposure. The dose from planned special exposures shall not be considered in controlling future occupational dose of the individual pursuant to D.6.A but shall be included in evaluations required by D.11.D and E.

12. Occupational Dose Limits for Minors. The annual occupational dose limits for minors are 10 percent of the annual occupational dose limits specified for adult workers in D.6.

13. Dose to an Embryo/Fetus.

A. The licensee or registrant shall ensure that the dose equivalent to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 5 mSv (0.5 rem). See D.46 for record keeping requirements.

B. The licensee or registrant shall make efforts to avoid substantial variation[2]/ above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the limit in D.13.A.

C. The dose equivalent to an embryo/fetus shall be taken as the sum of:

(1) The deep dose equivalent to the declared pregnant woman; and

(2) The dose equivalent to the embryo/fetus from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman.

D. If the dose equivalent to the embryo/fetus is found to have exceeded 0.5 rem (5 mSv), or is within 0.5 mSv (0.05 rem) of this dose, by the time the woman declares her pregnancy to the licensee or registrant, the licensee or registrant shall be deemed to be in compliance with paragraph A of this section if the additional dose equivalent does not exceed) 5mSv (0.05 rem) during the remainder of the pregnancy.

RADIATION DOSE LIMITS FOR INDIVIDUAL MEMBERS OF THE PUBLIC

14. Dose Limits for Individual Members of the Public.

A. Each licensee or registrant shall conduct operations so that:

(1) The total effective dose equivalent to individual members of the public from the licensed or registered operation does not exceed 1 mSv (0.1 rem) in a year, exclusive of the dose contribution from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with Part G, from voluntary participation in medical research programs, and from the licensee's or registrant's disposal of radioactive material into sanitary sewerage in accordance with D.35,[3]/ and

(2) The dose in any unrestricted area from external sources, exclusive of the dose contributions from patients administered radioactive material and released in accordance with Part G, does not exceed 0.02 mSv (0.002 rem) in any one hour.

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[2]/ The National Council on Radiation Protection and Measurements recommended in NCRP Report No. 91 "Recommendations on Limits for Exposure to Ionizing Radiation" (June 1, 1987) that no more than 0.5 mSv (0.05 rem) to the embryo/fetus be received in any one month.

[3]/ Retrofit shall not be required for locations within facilities where only radiation machines existed prior to January 1, 1994 and met the previous requirements of 5 mSv (0.5 rem) in a year.

B. If the licensee or registrant permits members of the public to have access to controlled areas, the limits for members of the public continue to apply to those individuals.

C. Not withstanding paragraph A.(1) of this section, a licensee may permit visitors to an individual who can not be released in accordance with Part G, to receive a radiation dose greater than 1 mSv (0.1 rem) if:

(1) The radiation dose received does not exceed 5 mSv (0.5 rem); and

(2) The authorized user, as defined in Part G, has determined before the visit that it is appropriate.

D. A licensee, registrant, or an applicant for a license or registration may apply for prior Agency authorization to operate up to an annual dose limit for an individual member of the public of 5 mSv (0.5 rem). This application shall include the following information:

(1) Demonstration of the need for and the expected duration of operations in excess of the limit in D.14.A; and

(2) The licensee's or registrant's program to assess and control dose within the 5 mSv (0.5 rem) annual limit; and

(3) The procedures to be followed to maintain the dose ALARA.

E. In addition to the requirements of Part D, a licensee or registrant subject to the provisions of the U.S. Environmental Protection Agency's generally applicable environmental radiation standards in 40 CFR 190 shall comply with those standards.

F. The Agency may impose additional restrictions on radiation levels in unrestricted areas and on the total quantity of radionuclides that a licensee or registrant may release in effluents in order to restrict the collective dose.

15. Compliance with Dose Limits for Individual Members of the Public.

A. The licensee or registrant shall make or cause to be made surveys of radiation levels in unrestricted and controlled areas and radioactive materials in effluents released to unrestricted and controlled areas to demonstrate compliance with the dose limits for individual members of the public in D.14.

B. A licensee or registrant shall show compliance with the annual dose limit in D.14 by:

(1) Demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed or registered operation does not exceed the annual dose limit; or

(2) Demonstrating that:

a. The annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in Table II of Appendix B; and

b. If an individual were continually present in an unrestricted area, the dose from external sources would not exceed 0.02 mSv (0.002 rem) in an hour and 0.5 mSv (0.05 rem) in a year.

C. Upon approval from the Agency, the licensee or registrant may adjust the effluent concentration values in Appendix B, Table II, for members of the public, to take into account the actual physical and chemical characteristics of the effluents, such as, aerosol size distribution, solubility, density, radioactive decay equilibrium, and chemical form.

TESTING FOR LEAKAGE OR CONTAMINATION OF SEALED SOURCES

16. Testing for Leakage or Contamination of Sealed Sources.

A. The licensee or registrant in possession of any sealed source shall assure that:

(1) Each sealed source, except as specified in D.16.B, is tested for leakage or contamination and the test results are received before the sealed source is put into use unless the licensee or registrant has a certificate from the transferor indicating that the sealed source was tested within 6 months before transfer to the licensee or registrant.

(2) Each sealed source that is not designed to emit alpha particles is tested for leakage or contamination at intervals not to exceed 6 months or at alternative intervals approved by the Agency, after evaluation of information specified by C.11.K.(4) and (5) of these regulations, an Agreement State, a Licensing State, or the U.S. Nuclear Regulatory Commission.

(3) Each sealed source that is designed to emit alpha particles is tested for leakage or contamination at intervals not to exceed 3 months or at alternative intervals approved by the Agency, after evaluation of information specified by C.11.K.(4) and (5) of these regulations, an Agreement State, a Licensing State, or the Nuclear Regulatory Commission.

(4) For each sealed source that is required to be tested for leakage or contamination, at any other time there is reason to suspect that the sealed source might have been damaged or might be leaking, the licensee or registrant shall assure that the sealed source is tested for leakage or contamination before further use.

(5) Tests for leakage for all sealed sources, except brachytherapy sources manufactured to contain radium, shall be capable of detecting the presence of 185 Bq (0.005 μCi) of radioactive material on a test sample. Test samples shall be taken from the sealed source or from the surfaces of the container in which the sealed source is stored or mounted on which one might expect contamination to accumulate. For a sealed source contained in a device, test samples are obtained when the source is in the "off" position.

(6) The test for leakage for brachytherapy sources manufactured to contain radium shall be capable of detecting an absolute leakage rate of 37 Bq (0.001 μCi) of radon-222 in a 24 hour period when the collection efficiency for radon-222 and its daughters has been determined with respect to collection method, volume and time.

(7) Tests for contamination from radium daughters shall be taken on the interior surface of brachytherapy source storage containers and shall be capable of detecting the presence of 185 Bq (0.005 μCi) of a radium daughter which has a half-life greater than 4 days.

B. A licensee or registrant need not perform test for leakage or contamination on the following sealed sources:

(1) Sealed sources containing only radioactive material with a half-life of less than 30 days;

(2) Sealed sources containing only radioactive material as a gas;

(3) Sealed sources containing 3.7 MBq (100 μCi) or less of beta or photon- emitting material or 370 kBq (10 μCi) or less of alpha-emitting material;

(4) Sealed sources containing only hydrogen-3;

(5) Seeds of iridium-192 encased in nylon ribbon; and

(6) Sealed sources, except teletherapy and brachytherapy sources, which are stored, not being used and identified as in storage. The licensee or registrant shall, however, test each such sealed source for leakage or contamination and receive the test results before any use or transfer unless it has been tested for leakage or contamination within 6 months before the date of use or transfer.

C. Tests for leakage or contamination from sealed sources shall be performed by persons specifically authorized by the Agency, an Agreement State, a Licensing State, or the U.S. Nuclear Regulatory Commission to perform such services.

D. Test results shall be kept in units of becquerel or microcurie and maintained for inspection by the Agency.

E. The following shall be considered evidence that a sealed source is leaking:

(1) The presence of 185 Bq (0.005 μCi) or more of removable contamination on any test sample.

(2) Leakage of 37 Bq (0.001 μCi) of radon-222 per 24 hours for brachytherapy sources manufactured to contain radium.

(3) The presence of removable contamination resulting from the decay of 185 Bq (0.005 μCi) or more of radium.

F. The licensee or registrant shall immediately withdraw a leaking sealed source from use and shall take action to prevent the spread of contamination. The leaking sealed source shall be repaired or disposed of in accordance with this Part.

G. Reports of test results for leaking or contaminated sealed sources shall be made pursuant to D.58.

SURVEYS AND MONITORING

17. General.

A. Each licensee or registrant shall make, or cause to be made, surveys that:

(1) Are necessary for the licensee or registrant to comply with Part D; and

(2) Are necessary under the circumstances to evaluate:

(a) The magnitude of radiation levels; and

(b) Concentrations or quantities of radioactive material; and

(c) The potential radiological hazards.

B. The licensee or registrant shall ensure that instruments and equipment used for quantitative radiation measurements, for example, dose rate and effluent monitoring, are calibrated at intervals not to exceed 12 months for the radiation measured.

C. All personnel dosimeters, except for direct and indirect reading pocket ionization chambers and those dosimeters used to measure the dose to any extremity, that require processing to determine the radiation dose and that are used by licensees and registrants to comply with D.6, with other applicable provisions of these regulations, or with conditions specified in a license or registration shall be processed and evaluated by a dosimetry processor:

(1) Holding current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology; and

(2) Approved in this accreditation process for the type of radiation or radiations included in the NVLAP program that most closely approximates the type of radiation or radiations for which the individual wearing the dosimeter is monitored.

D. The licensee or registrant shall ensure that adequate precautions are taken to prevent a deceptive exposure of an individual monitoring device.

18. Conditions Requiring Individual Monitoring of External and Internal Occupational Dose.

Each licensee or registrant shall monitor exposures from sources of radiation at levels sufficient to demonstrate compliance with the occupational dose limits of Part D. As a minimum:

A. Each licensee or registrant shall monitor occupational exposure to radiation from licensed and unlicensed radiation sources under the control of the licensee and shall supply and require the use of individual monitoring devices by:

(1) Adults likely to receive, in 1 year from sources external to the body, a dose in excess of 10 percent of the limits in D.6.A; and

(2) Minors likely to receive, in 1 year from sources external to the body, a deep dose equivalent in excess of 1 mSv (0.1 rem), a lens dose equivalent in excess of 1.5 mSv (0.15 rem), or a shallow dose equivalent to the skin or to the extremities in excess of 5 mSv (0.5 rem; and

(3) Declared pregnant women likely to receive during the entire pregnancy, in 1 year from sources external to the body, a deep dose equivalent in excess of 1 mSv (0.1 rem; and

(4) Individuals entering a high or very high radiation area.

(5) *Reserved*

B. Each licensee or registrant shall monitor, to determine compliance with D.9, the occupational intake of radioactive material by and assess the committed effective dose equivalent to:

(1) Adults likely to receive, in 1 year, an intake in excess of 10 percent of the applicable ALI in Table I, Columns 1 and 2, of Appendix B; and

(2) Minors and declared pregnant women (during the entire pregnancy) likely to receive, in 1 year from radiation sources external to the body, a committed effective dose equivalent in excess of 1 mSv (0.1 rem).

CONTROL OF EXPOSURE FROM EXTERNAL SOURCES IN RESTRICTED AREAS

19. Control of Access to High Radiation Areas.

A. The licensee or registrant shall ensure that each entrance or access point to a high radiation area has one or more of the following features:

(1) A control device that, upon entry into the area, causes the level of radiation to be reduced below that level at which an individual might receive a deep dose equivalent of 1 mSv (0.1 rem) in 1 hour at 30 centimeters from the source of radiation or from any surface that the radiation penetrates; or

(2) A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry; or

(3) Entryways that are locked, except during periods when access to the areas is required, with positive control over each individual entry.

B. In place of the controls required by D.19.A for a high radiation area, the licensee or registrant may substitute continuous direct or electronic surveillance that is capable of preventing unauthorized entry.

C. The licensee or registrant may apply to the Agency for approval of alternative methods for controlling access to high radiation areas.

D. The licensee or registrant shall establish the controls required by D.19.A and C in a way that does not prevent individuals from leaving a high radiation area.

E. The licensee or registrant is not required to control each entrance or access point to a room or other area that is a high radiation area solely because of the presence of radioactive materials prepared for transport and packaged and labeled in accordance with the regulations of the U.S. Department of Transportation provided that:

(1) The packages do not remain in the area longer than 3 days; and

(2) The dose rate at 1 meter from the external surface of any package does not exceed 0.1 mSv (0.01 rem) per hour.

F. The licensee or registrant is not required to control entrance or access to rooms or other areas in hospitals solely because of the presence of patients containing radioactive material, provided that there are personnel in attendance who are taking the necessary precautions to prevent the exposure of individuals to radiation or radioactive material in excess of the established limits in Part D and to operate within the ALARA provisions of the licensee's or registrant's radiation protection program.

G. The registrant is not required to control entrance or access to rooms or other areas containing sources of radiation capable of producing a high radiation area as described in D.19 if the registrant has met all the specific requirements for access and control specified in other applicable Parts of these regulations, such as, Part E for industrial radiography, Part F for x rays in the healing arts, and Part I for particle accelerators.

20. Control of Access to Very High Radiation Areas.

A. In addition to the requirements in D.19, the licensee or registrant shall institute measures to ensure that an individual is not able to gain unauthorized or inadvertent access to areas in which radiation levels could be encountered at 5 Gy (500 rad) or more in 1 hour at 1 meter from a source of radiation or any surface through which the radiation penetrates. This requirement does not apply to rooms or areas in which diagnostic x-ray systems are the only source of radiation, or to non-self-shielded irradiators.

B. The registrant is not required to control entrance or access to rooms or other areas containing sources of radiation capable of producing a very high radiation area as described in D.20.A if the registrant has met all the specific requirements for access and control specified in other applicable Parts of these regulations, such as, Part E for industrial radiography, Part F for x rays in the healing arts, and Part I for particle accelerators.

21. Control of Access to Very High Radiation Areas -- Irradiators.

A. Section D.21 applies to licensees or registrants with sources of radiation in non-self-shielded irradiators. Section D.21 does not apply to sources of radiation that are used in teletherapy, in industrial radiography, or in completely self-shielded irradiators in which the source of radiation is both stored and operated within the same shielding radiation barrier and, in the designed configuration of the irradiator, is always physically inaccessible to any individual and cannot create high levels of radiation in an area that is accessible to any individual.

B. Each area in which there may exist radiation levels in excess of 5 Gy (500 rad) in 1 hour at 1 meter from a source of radiation that is used to irradiate materials shall meet the following requirements:

(1) Each entrance or access point shall be equipped with entry control devices which:

a. Function automatically to prevent any individual from inadvertently entering a very high radiation area; and

b. Permit deliberate entry into the area only after a control device is actuated that causes the radiation level within the area, from the source of radiation, to be reduced below that at which it would be possible for an individual to receive a deep dose equivalent in excess of 1 mSv (0.1 rem) in 1 hour; and

c. Prevent operation of the source of radiation if it would produce radiation levels in the area that could result in a deep dose equivalent to an individual in excess of 1 mSv (0.1 rem) in 1 hour.

(2) Additional control devices shall be provided so that, upon failure of the entry control devices to function as required by D.21.B(1):

a. The radiation level within the area, from the source of radiation, is reduced below that at which it would be possible for an individual to receive a deep dose equivalent in excess of 1 mSv (0.1 rem) in 1 hour; and

b. Conspicuous visible and audible alarm signals are generated to make an individual attempting to enter the area aware of the hazard and at least one other authorized individual, who is physically present, familiar with the activity, and prepared to render or summon assistance, aware of the failure of the entry control devices.

(3) The licensee or registrant shall provide control devices so that, upon failure or removal of physical radiation barriers other than the sealed source's shielded storage container:

a. The radiation level from the source of radiation is reduced below that at which it would be possible for an individual to receive a deep dose equivalent in excess of 1 mSv (0.1 rem) in 1 hour; and

b. Conspicuous visible and audible alarm signals are generated to make potentially affected individuals aware of the hazard and the licensee or registrant or at least one other individual, who is familiar with the activity and prepared to render or summon assistance, aware of the failure or removal of the physical barrier.

(4) When the shield for stored sealed sources is a liquid, the licensee or registrant shall provide means to monitor the integrity of the shield and to signal, automatically, loss of adequate shielding.

(5) Physical radiation barriers that comprise permanent structural components, such as walls, that have no credible probability of failure or removal in ordinary circumstances need not meet the requirements of D.21.B(3) and (4).

(6) Each area shall be equipped with devices that will automatically generate conspicuous visible and audible alarm signals to alert personnel in the area before the source of radiation can be put into operation and in time for any individual in the area to operate a clearly identified control device, which must be installed in the area and which can prevent the source of radiation from being put into operation.

(7) Each area shall be controlled by use of such administrative procedures and such devices as are necessary to ensure that the area is cleared of personnel prior to each use of the source of radiation.

(8) Each area shall be checked by a radiation measurement to ensure that, prior to the first individual's entry into the area after any use of the source of radiation, the radiation level from the source of radiation in the area is below that at which it would be possible for an individual to receive a deep dose equivalent in excess of 1 mSv (0.1 rem) in 1 hour.

(9) The entry control devices required in D.21.B(1) shall be tested for proper functioning. See D.49 for record keeping requirements.

(a) Testing shall be conducted prior to initial operation with the source of radiation on any day, unless operations were continued uninterrupted from the previous day; and

(b) Testing shall be conducted prior to resumption of operation of the source of radiation after any unintentional interruption; and

(c) The licensee or registrant shall submit and adhere to a schedule for periodic tests of the entry control and warning systems.

(10) The licensee or registrant shall not conduct operations, other than those necessary to place the source of radiation in safe condition or to effect repairs on controls, unless control devices are functioning properly.

(11) Entry and exit portals that are used in transporting materials to and from the irradiation area, and that are not intended for use by individuals, shall be controlled by such devices and administrative procedures as are necessary to physically protect and warn against inadvertent entry by any individual through these portals. Exit portals for irradiated materials shall be equipped to detect and signal the presence of any loose radioactive material that is carried toward such an exit and automatically to prevent loose radioactive material from being carried out of the area.

C. Licensees, registrants, or applicants for licenses or registrations for sources of radiation within the purview of D.21.B which will be used in a variety of positions or in locations, such as open fields or forests, that make it impracticable to comply with certain requirements of D.21.B, such as those for the automatic control of radiation levels, may apply to the Agency for approval of alternative safety measures. Alternative safety measures shall provide personnel protection at least equivalent to those specified in D.21.B. At least one of the alternative measures shall include an entry-preventing interlock control based on a measurement of the radiation that ensures the absence of high radiation levels before an individual can gain access to the area where such sources of radiation are used.

D. The entry control devices required by D.21.B and C shall be established in such a way that no individual will be prevented from leaving the area.

RESPIRATORY PROTECTION AND CONTROLS TO RESTRICT INTERNAL EXPOSURE IN RESTRICTED AREAS

22. Use of Process or Other Engineering Controls. The licensee or registrant shall use, to the extent practicable, process or other engineering controls, such as, containment, decontamination or ventilation, to control the concentrations of radioactive material in air.

23. Use of Other Controls.

A. When it is not practical to apply process or other engineering controls to control the concentrations of radioactive material in air to values below those that define an airborne radioactivity area, the licensee or registrant shall, consistent with maintaining the total effective dose equivalent ALARA, increase monitoring and limit intakes by one or more of the following means:

(1) Control of access; or

(2) Limitation of exposure times; or

(3) Use of respiratory protection equipment; or

(4) Other controls.

B. If the licensee performs an ALARA analysis to determine whether or not respirators should be used, the licensee may consider safety factors other than radiological factors. The licensee should also consider the impact of respirator use on workers' industrial health and safety.

24. Use of Individual Respiratory Protection Equipment.

A. If the licensee or registrant assigns or permits the use respiratory protection equipment to limit the intake of radioactive material pursuant to D.23,

(1) Except as provided in D.24.A(2), the licensee or registrant shall use only respiratory protection equipment that is tested and certified by the National Institute for Occupational Safety and Health (NIOSH).

(2) If the licensee or registrant wishes to use equipment that has not been tested or certified by the National Institute for Occupational Safety and Health, the licensee or registrant shall submit an application for authorized use of that equipment, including a demonstration by testing, or a demonstration on the basis of reliable test information, that the material and performance characteristics of the equipment are capable of providing the proposed degree of protection under anticipated conditions of use. This must be demonstrated either by licensee testing or on the basis of reliable test information.

(3) The licensee or registrant shall implement and maintain a respiratory protection program that includes:

a. Air sampling sufficient to identify the potential hazard, permit proper equipment selection, and estimate doses; Note: In those cases where air sampling is difficult or even impossible, the exposure can be calculated based upon the known chemicals and ventilation rates; and

b. Surveys and bioassays, as appropriate, to evaluate actual intakes; and

c. Testing of respirators for operability (user seal check for face sealing devices and functional check for others) immediately prior to each use; and

d. Written procedures regarding respirator selection, fit testing, storage, issuance, maintenance, repair, testing of respirators, including testing for operability immediately prior to each use; quality assurance of respiratory protection equipment supervision and training of respirator users; monitoring, including air sampling and bioassays; breathing air quality, inventory and control, and recordkeeping; and limitations on periods of respirator use and relief from respirator use; and

e. Determination by a physician that the individual user is medically fit to use the respiratory protection equipment; before.

(i) The initial fitting of a face sealing respirator;

(ii) Before the first field use of non-face sealing respirators, and

(iii) Either every 12 months thereafter, or periodically at a frequency determined by a physician.

f. Fit testing, with a fit factor ≥ 10 times the APF for negative pressure devices, and a fit factor ≥ 500 for any positive pressure, continuous flow, and pressure-demand devices, before the first field use of tight fitting, face sealing respirators and periodically thereafter at a frequency not to exceed 1 year. Fit testing must be performed with the facepiece operating in the negative pressure mode.

(5) The licensee or registrant shall advise each respirator user that the user may leave the area at any time for relief from respirator use in the event of equipment malfunction, physical or psychological distress, procedural or communication failure, significant deterioration of operating conditions, or any other conditions that might require such relief.

(6) The licensee or registrant shall use respiratory protection equipment within the equipment manufacturer's expressed limitations for type and mode of use and shall provide for vision correction, adequate communication, low temperature work environments and the concurrent use of other safety or radiological protection equipment. The licensee shall use equipment in such a way as not to interfere with the proper operation of the respirator.

(7) Standby rescue persons are required whenever one-piece atmosphere-supplying suits, or any combination of supplied air respiratory protection device and personnel protective equipment are used from which an unaided individual would have difficulty extricating himself or herself. The standby persons must be equipped with respiratory protection devices or other apparatus appropriate for the potential hazards. The standby rescue persons shall observe or otherwise maintain continuous communication with the workers (visual, voice, signal line, telephone, radio, or other suitable means), and be immediately available to assist them in case of a failure of the air supply or for any other reason that requires relief from distress. A sufficient number of standby rescue persons must be immediately available to assist all users of this type of equipment and to provide effective emergency rescue if needed.

(8) Atmosphere-supplying respirators must be supplied with respirable air of grade D quality or better as defined by the Compressed gas Association in publication G-7.1, “Commodity Specification for Air, “ 1997 and included in the regulations of the Occupational Safety and Health Administration (29 CFR 1910.134(i)1(ii)(A) through (E). Grade D quality air criteria include:

a. Oxygen content (v/v) of 19.5-23.5%;

b. Hydrocarbon (condensed) content of 5 milligrams per cubic meter or air or less;

c. Carbon Monoxide (CO) content of 10 ppm or less;

d. Carbon Dioxide content of 1,000 ppm or less; and

e. Lack of noticeable odor

(9) The licensee shall ensure that no objects, materials or substances, such as facial hair, or any conditions that interfere with the face-facepiece seal or valve function, and that are under the control of the wearer, are present between the skin of the wearer’s face and the sealing surface of a tight-fitting respirator facepiece.

(10) In estimating the dose to individuals from intake of airborne radioactive materials, the concentration of radioactive material in the air that is inhaled when respirators are worn is initially assumed to be the ambient concentration in air without the respiratory protection, divided by the assigned protection factor. If the dose is later found to be greater than the estimated dose, the corrected value must be used. If the dose is later found to be less than the estimated dose, the corrected value may be used.

B. The Agency may impose restrictions in addition to the provisions of D.23 and D.24, and Appendix A of this Part, in order to:

(1) Ensure that the respiratory protection program of the licensee is adequate to limit doses to individuals from intakes of radioactive materials consistent with maintaining total effective dose equivalent ALARA; and

(2) Limit the extent to which a licensee may use respiratory protection equipment instead of process or other engineering controls.

C. The licensee or registrant shall obtain authorization from the Agency before using assigned respiratory protection factors in excess of those specified in Appendix A. The Agency may authorize a licensee or registrant to use higher protection factors on receipt of an application that:

(1) Describes the situation for which a need exists for higher protection factors, and

(2) Demonstrates that the respiratory protection equipment provides these higher protection factors under the proposed conditions of use.

STORAGE AND CONTROL OF LICENSED OR REGISTERED SOURCES OF RADIATION

25. Security of Stored Sources of Radiation. The licensee or registrant shall secure from unauthorized removal or access licensed or registered sources of radiation that are stored in controlled or unrestricted areas.

26. Control of Sources of Radiation not in Storage

A. The licensee or registrant shall control and maintain constant surveillance of licensed or registered radioactive material that is in a controlled or unrestricted area and that is not in storage.

B. The registrant shall maintain control of radiation machines that are in a controlled or unrestricted area and that are not in storage.

PRECAUTIONARY PROCEDURES

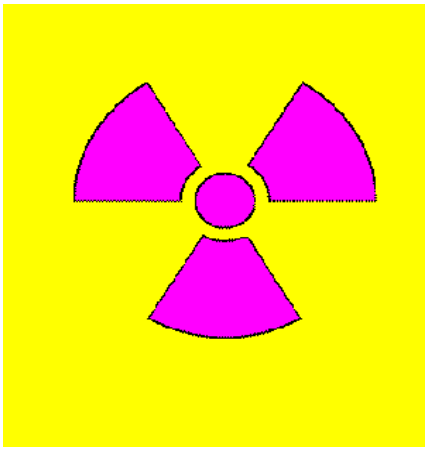
27. Caution Signs.

A. Standard Radiation Symbol. Unless otherwise authorized by the Agency, the symbol prescribed by D.27 shall use the colors magenta, or purple, or black on yellow background. The symbol prescribed is the three-bladed design as follows:

RADIATION SYMBOL

(1) Cross-hatched area is to be magenta, or purple, or black, and

(3) The background is to be yellow.



B Exception to Color Requirements for Standard Radiation Symbol. Notwithstanding the requirements of D.27.A, licensees or registrants are authorized to label sources, source holders, or device components containing sources of radiation that are subjected to high temperatures, with conspicuously etched or stamped radiation caution symbols and without a color requirement.

C. Additional Information on Signs and Labels. In addition to the contents of signs and labels prescribed in Part D, the licensee or registrant shall provide, on or near the required signs and labels, additional information, as appropriate, to make individuals aware of potential radiation exposures and to minimize the exposures.

28. Posting Requirements

A. Posting of Radiation Areas. The licensee or registrant shall post each radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIATION AREA."

B. Posting of High Radiation Areas. The licensee or registrant shall post each high radiation area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, HIGH RADIATION AREA" or "DANGER, HIGH RADIATION AREA."

C. Posting of Very High Radiation Areas. The licensee or registrant shall post each very high radiation area with a conspicuous sign or signs bearing the radiation symbol and words "GRAVE DANGER, VERY HIGH RADIATION AREA."

D. Posting of Airborne Radioactivity Areas. The licensee or registrant shall post each airborne radioactivity area with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA."

E. Posting of Areas or Rooms in which Licensed or Registered Material is Used or Stored. The licensee or registrant shall post each area or room in which there is used or stored an amount of licensed or registered material exceeding 10 times the quantity of such material specified in Appendix C with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL(S)" or "DANGER, RADIOACTIVE MATERIAL(S)."

29. Exceptions to Posting Requirements.

A. A licensee or registrant is not required to post caution signs in areas or rooms containing sources of radiation for periods of less than 8 hours, if each of the following conditions is met:

(1) The sources of radiation are constantly attended during these periods by an individual who takes the precautions necessary to prevent the exposure of individuals to sources of radiation in excess of the limits established in Part D; and

(2) The area or room is subject to the licensee's or registrant's control.

B. Rooms or other areas in hospitals that are occupied by patients are not required to be posted with caution signs pursuant to D.28 provided that the patient could be released from confinement pursuant to G.27 of these regulations.

C. A room or area is not required to be posted with a caution sign because of the presence of a sealed source provided the radiation level at 30 centimeters from the surface of the sealed source container or housing does not exceed 0.05 mSv (0.005 rem) per hour.

D. Rooms in hospitals or clinics that are used for teletherapy are exempt from the requirement to post caution signs under D.28 if:

(1) Access to the room is controlled pursuant to G.604; and

(2) Personnel in attendance take necessary precautions to prevent the inadvertent exposure of workers, other patients, and members of the public to radiation in excess of the limits established in this part.

E. A room or area is not required to be posted with a caution sign because of the presence of radiation machines used solely for diagnosis in the healing arts.

30. Labeling Containers and Radiation Machines.

A. The licensee or registrant shall ensure that each container of licensed or registered material bears a durable, clearly visible label bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL" or "DANGER, RADIOACTIVE MATERIAL." The label shall also provide information, such as the radionuclides present, an estimate of the quantity of radioactivity, the date for which the activity is estimated, radiation levels, kinds of materials, and mass enrichment, to permit individuals handling or using the containers, or working in the vicinity of the containers, to take precautions to avoid or minimize exposures.

B. Each licensee or registrant shall, prior to removal or disposal of empty uncontaminated containers to unrestricted areas, remove or deface the radioactive material label or otherwise clearly indicate that the container no longer contains radioactive materials.

C. Each registrant shall ensure that each radiation machine is labeled in a conspicuous manner, which cautions individuals that radiation is produced when it is energized.

31. Exemptions to Labeling Requirements.

A licensee or registrant is not required to label:

A. Containers holding licensed or registered material in quantities less than the quantities listed in Appendix C; or

B. Containers holding licensed or registered material in concentrations less than those specified in Table III of Appendix B; or

C. Containers attended by an individual who takes the precautions necessary to prevent the exposure of individuals in excess of the limits established by Part D; or

D. Containers when they are in transport and packaged and labeled in accordance with the regulations of the U.S. Department of Transportation;[4]/ or

E. Containers that are accessible only to individuals authorized to handle or use them, or to work in the vicinity of the containers, if the contents are identified to these individuals by a readily available written record. Examples of containers of this type are containers in locations such as water filled canals, storage vaults, or hot cells. The record shall be retained as long as the containers are in use for the purpose indicated on the record; or

F. Installed manufacturing or process equipment, such as piping and tanks.

32. Procedures for Receiving and Opening Packages.

A. Each licensee or registrant who expects to receive a package containing quantities of radioactive material in excess of a Type A quantity, as defined in L.2 and Appendix A of Part L of these regulations, shall make arrangements to receive:

(1) The package when the carrier offers it for delivery; or

(2) The notification of the arrival of the package at the carrier's terminal and to take possession of the package expeditiously.

B. Each licensee or registrant shall:

(1) Monitor the external surfaces of a labeled[5]/ package for radioactive contamination unless the package contains only radioactive material in the form of gas or in special form as defined in A.2 of these regulations; and

(2) Monitor the external surfaces of a labeled[5]/ package for radiation levels unless the package contains quantities of radioactive material that are less than or equal to the Type A quantity, as defined in L.2 and Appendix A to Part L of these regulations; and

(3) Monitor all packages known to contain radioactive material for radioactive contamination and radiation levels if there is evidence of degradation of package integrity, such as packages that are crushed, wet, or damaged.

C. The licensee or registrant shall perform the monitoring required by D.32.B as soon as practicable after receipt of the package, but not later than 3 hours after the package is received at the licensee's or registrant's facility if it is received during the licensee's or registrant's normal working hours, or not later than 3 hours from the beginning of the next working day if it is received after working hours.

D. The licensee or registrant shall immediately notify the final delivery carrier and the Agency by telephone and telegram, mailgram, or facsimile, when:

(1) Removable radioactive surface contamination exceeds the limits of L.15.H. of these regulations; or

(2) External radiation levels exceed the limits of L.15.I and J of these regulations.

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[4]/ Labeling of packages containing radioactive materials is required by the U.S. Department of Transportation if the amount and type of radioactive material exceeds the limits for an excepted quantity or article as defined and limited by U.S. Department of Transportation regulations 49 CFR 173.403(m) and (w) and 173.421-424.

[5]/ Labeled with a Radioactive White I, Yellow II, or Yellow III label as specified in U.S. Department of Transportation regulations 49 CFR 172.403 and 172.436-440.

E. Each licensee or registrant shall:

(1) Establish, maintain, and retain written procedures for safely opening packages in which radioactive material is received; and

(2) Ensure that the procedures are followed and that due consideration is given to special instructions for the type of package being opened.

F. Licensees or registrants transferring special form sources in vehicles owned or operated by the licensee or registrant to and from a work site are exempt from the contamination monitoring requirements of D.32.B, but are not exempt from the monitoring requirement in D.32.B for measuring radiation levels that ensures that the source is still properly lodged in its shield.

WASTE DISPOSAL

33. General Requirements.

A. A licensee or registrant shall dispose of licensed or registered material only:

(1) By transfer to an authorized recipient as provided in D.38, or in Parts C, M, or U[6]/ of these regulations, or to the U.S. Department of Energy; or

(2) By decay in storage; or

(3) By release in effluents within the limits in D.14; or

(4) As authorized pursuant to D.34, D.35, D.36, or D.37.

B. A person shall be specifically licensed or registered to receive waste containing licensed or registered material from other persons for:

(1) Treatment prior to disposal; or

(2) Treatment or disposal by incineration; or

(3) Decay in storage; or

(4) Disposal at a land disposal facility licensed pursuant to Part M; or

(5) Storage until transferred to a storage or disposal facility authorized to receive the waste.

34. Method for Obtaining Approval of Proposed Disposal Procedures. A licensee or registrant or applicant for a license or registration may apply to the Agency for approval of proposed procedures, not otherwise authorized in these regulations, to dispose of licensed or registered material generated in the licensee's or registrant's operations. Each application shall include:

A. A description of the waste containing licensed or registered material to be disposed of, including the physical and chemical properties that have an impact on risk evaluation, and the proposed manner and conditions of waste disposal; and

B. An analysis and evaluation of pertinent information on the nature of the environment; and

[6]/ Part M and U are reserved.

C. The nature and location of other potentially affected facilities; and

D. Analyses and procedures to ensure that doses are maintained ALARA and within the dose limits in Part D.

35. Disposal by Release into Sanitary Sewerage

A. A licensee or registrant may discharge licensed or registered material into sanitary sewerage if each of the following conditions is satisfied:

(1) The material is readily soluble, or is readily dispersible biological material, in water; and

(2) The quantity of licensed or registered radioactive material that the licensee or registrant releases into the sewer in 1 month divided by the average monthly volume of water released into the sewer by the licensee or registrant does not exceed the concentration listed in Table III of Appendix B; and

(3) If more than one radionuclide is released, the following conditions must also be satisfied:

a. The licensee or registrant shall determine the fraction of the limit in Table III of Appendix B represented by discharges into sanitary sewerage by dividing the actual monthly average concentration of each radionuclide released by the licensee or registrant into the sewer by the concentration of that radionuclide listed in Table III of Appendix B; and

b. The sum of the fractions for each radionuclide required by D.35.A(3)(a) does not exceed unity; and

(4) The total quantity of licensed or registered radioactive material that the licensee or registrant releases into the sanitary sewerage in a year does not exceed 185 GBq (5 Ci) of hydrogen-3, 37 GBq (1 Ci) of carbon-14, and 37 GBq (1 Ci) of all other radioactive materials combined.

B. Excreta from individuals undergoing medical diagnosis or therapy with radioactive material are not subject to the limitations contained in D.35.A.

36. Treatment or Disposal by Incineration. A licensee or registrant may treat or dispose of licensed or registered material by incineration only in the amounts and forms specified in D.37 or as specifically approved by the Agency pursuant to D.34.

37. Disposal of Specific Wastes.

A. A licensee or registrant may dispose of the following licensed or registered material as if it were not radioactive:

(1) 1.85 kBq (0.05 μCi), or less, of hydrogen-3 or carbon-14 per gram of medium used for liquid scintillation counting; and

(2) 1.85 kBq (0.05 μCi), or less, of hydrogen-3 or carbon-14 per gram of animal tissue, averaged over the weight of the entire animal.

B. A licensee or registrant shall not dispose of tissue pursuant to D.37.A(2) in a manner that would permit its use either as food for humans or as animal feed.

C. The licensee or registrant shall maintain records in accordance with D.48.

38. Transfer for Disposal and Manifests.

A. The requirements of D.38, Appendices D and G of this Part are designed to control transfers of low-level radioactive waste intended for disposal at a licensed low- level radioactive waste disposal facility, establish a manifest tracking system, and supplement existing requirements concerning transfers and record keeping for those wastes.

B. Each shipment of radioactive waste designated for disposal at a licensed low-level radioactive waste disposal facility shall be accompanied by a shipment manifest as specified in Section I of Appendix D.

C. Each shipment manifest shall include a certification by the waste generator as specified in Section II of Appendix D.

D. Each person involved in the transfer of waste for disposal or in the disposal of waste, including the waste generator, waste collector, waste processor, and disposal facility operator, shall comply with the requirements specified in Section III of Appendix D.

39. Compliance with Environmental and Health Protection Regulations. Nothing in D.33, D.34, D.35, D.36, D.37, or D.38 relieves the licensee or registrant from complying with other applicable Federal, State and local regulations governing any other toxic or hazardous properties of materials that may be disposed of to D.33, D.34, D.35, D.36, D.37, or D.38.

RECORDS

40. General Provisions.

A. Each licensee or registrant shall use the units (curie, rad, rem and roentgen) including multiples and subdivisions, and shall clearly indicate the units of all quantities on records required by Part D.

B. In the records required by this Part, the licensee may record quantities in the International System of Units (SI) in parentheses following each of the units specified in paragraph A. However, all quantities must be recorded as stated in paragraph A.

C. Not withstanding the requirements of paragraph A of this section, when recording information on shipment manifests, as required in D.38, information must be recorded in SI units or in SI units and units as specified in paragraph A above.

D. The licensee or registrant shall make a clear distinction among the quantities entered on the records required by Part D, such as, total effective dose equivalent, total organ dose equivalent, shallow dose equivalent, lens dose equivalent, deep dose equivalent, or committed effective dose equivalent.

41. Records of Radiation Protection Programs.

A. Each licensee or registrant shall maintain records of the radiation protection program, including:

(1) The provisions of the program; and

(2) Audits and other reviews of program content and implementation.

B. The licensee or registrant shall retain the records required by D.41.A(1) until the Agency terminates each pertinent license or registration requiring the record. The licensee or registrant shall retain the records required by D.41.A(2) for 3 years after the record is made.

42. Records of Surveys.

A. Each licensee or registrant shall maintain records showing the results of surveys and calibrations required by D.17 and D.32.B. The licensee or registrant shall retain these records for 3 years after the record is made.

B. The licensee or registrant shall retain each of the following records until the Agency terminates each pertinent license or registration requiring the record:

(1) Records of the results of surveys to determine the dose from external sources of radiation used, in the absence of or in combination with individual monitoring data, in the assessment of individual dose equivalents; and

(2) Records of the results of measurements and calculations used to determine individual intakes of radioactive material and used in the assessment of internal dose; and

(3) Records showing the results of air sampling, surveys, and bioassays required pursuant to D.24.A(3)(a) and (b); and

(4) Records of the results of measurements and calculations used to evaluate the release of radioactive effluents to the environment.

C. Upon termination of the license or registration, the licensee or registrant shall permanently store records on HHE-835 or equivalent, or shall make provision with the Agency for transfer to the Agency.

43. Records of Tests for Leakage or Contamination of Sealed Sources. Records of tests for leakage or contamination of sealed sources required by D.16 shall be kept in units of becquerel or microcurie and maintained for inspection by the Agency for 5 years after the records are made.

44. Records of Prior Occupational Dose.

A. The licensee or registrant shall retain the records of prior occupational dose and exposure history as specified in D.10 on HHE 835 or equivalent until the Agency terminates each pertinent license or registration requiring this record. The licensee or registrant shall retain records used in preparing HHE 835 or equivalent for 3 years after the record is made.

B. Upon termination of the license or registration, the licensee or registrant shall permanently store records on HHE-835 or equivalent, or shall make provision with the Agency for transfer to the Agency.

45. Records of Planned Special Exposures.

A. For each use of the provisions of D.11 for planned special exposures, the licensee or registrant shall maintain records that describe:

(1) The exceptional circumstances requiring the use of a planned special exposure; and

(2) The name of the management official who authorized the planned special exposure and a copy of the signed authorization; and

(3) What actions were necessary; and

(4) Why the actions were necessary; and

(5) What precautions were taken to assure that doses were maintained ALARA; and

(6) What individual and collective doses were expected to result; and

(7) The doses actually received in the planned special exposure.

B. The licensee or registrant shall retain the records until the Agency terminates each pertinent license or registration requiring these records.

C. Upon termination of the license or registration, the licensee or registrant shall permanently store records on HHE-835 or equivalent, or shall make provision with the Agency for transfer to the Agency.

46. Records of Individual Monitoring Results.

A. Record keeping Requirement. Each licensee or registrant shall maintain records of doses received by all individuals for whom monitoring was required pursuant to D.18, and records of doses received during planned special exposures, accidents, and emergency conditions. Assessments of dose equivalent and records made using units in effect before January 1, 1994 need not be changed. These records shall include, when applicable:

(1) The deep dose equivalent to the whole body, lens dose equivalent, shallow dose equivalent to the skin, and shallow dose equivalent to the extremities; and

(2) The estimated intake of radionuclides, see D.7; and

(3) The committed effective dose equivalent assigned to the intake of radionuclides; and

(4) The specific information used to calculate the committed effective dose equivalent pursuant to D.9.C.; and

(5) The total effective dose equivalent when required by D.7; and

(6) The total of the deep dose equivalent and the committed dose to the organ receiving the highest total dose.

B. Record keeping Frequency. The licensee or registrant shall make entries of the records specified in D.46.A at intervals not to exceed 1 year.

C. Record keeping Format. The licensee or registrant shall maintain the records specified in D.46.A on HHE-840, in accordance with the instructions for HHE-840, or in clear and legible records containing all the information required by HHE-840.

D. The licensee or registrant shall maintain the records of dose to an embryo/fetus with the records of dose to the declared pregnant woman. The declaration of pregnancy, including the estimated date of conception, shall also be kept on file, but may be maintained separately from the dose records.

E. The licensee or registrant shall retain each required form or record until the Agency terminates each pertinent license or registration requiring the record.

F. Upon termination of the license or registration, the licensee or registrant shall permanently store records on HHE-835 or equivalent, or shall make provision with the Agency for transfer to the Agency.

47. Records of Dose to Individual Members of the Public.

A. Each licensee or registrant shall maintain records sufficient to demonstrate compliance with the dose limit for individual members of the public. See D.14.

B. The licensee or registrant shall retain the records required by D.47.A until the Agency terminates each pertinent license or registration requiring the record.

48. Records of Waste Disposal.

A. Each licensee or registrant shall maintain records of the disposal of licensed or registered materials made pursuant to D.34, D.35, D.36, D.37, of these regulations, and disposal by burial in soil, including burials authorized before January 28, 1981.[7]

B. The licensee or registrant shall retain the records required by D.48.A until the Agency terminates each pertinent license or registration requiring the record.

49. Records of Testing Entry Control Devices for Very High Radiation Areas.

A. Each licensee or registrant shall maintain records of tests made pursuant to D.21.B(9) on entry control devices for very high radiation areas. These records must include the date, time, and results of each such test of function.

B. The licensee or registrant shall retain the records required by D.49.A for 3 years after the record is made.

50. Form of Records. Each record required by Part D shall be legible throughout the specified retention period. The record shall be the original or a reproduced copy or a microform, provided that the copy or microform is authenticated by authorized personnel and that the microform is capable of producing a clear copy throughout the required retention period or the record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records, such as letters, drawings, and specifications, shall include all pertinent information, such as stamps, initials, and signatures. The licensee shall maintain adequate safeguards against tampering with and loss of records.

REPORTS

51. Reports of Stolen, Lost, or Missing Licensed or Registered Sources of Radiation.

A. Telephone Reports. Each licensee or registrant shall report to the Agency by telephone as follows:

(1) Immediately after its occurrence becomes known to the licensee or registrant, stolen, lost, or missing licensed or registered radioactive material in an aggregate quantity equal to or greater than 1,000 times the quantity specified in Appendix C under such circumstances that it appears to the licensee or registrant that an exposure could result to individuals in unrestricted areas; or

(2) Within 30 days after its occurrence becomes known to the licensee or registrant, lost, stolen, or missing licensed or registered radioactive material in an aggregate quantity greater than 10 times the quantity specified in Appendix C that is still missing.

(3) Immediately after its occurrence becomes known to the registrant, a stolen, lost, or missing radiation machine.

B. Written Reports. Each licensee or registrant required to make a report pursuant to D.51.A shall, within 30 days after making the telephone report, make a written report to the Agency setting forth the following information:

(1) A description of the licensed or registered source of radiation involved, including, for radioactive material, the kind, quantity, and chemical and physical form; and, for radiation machines, the manufacturer, model and serial number, type and maximum energy of radiation emitted;

(2) A description of the circumstances under which the loss or theft occurred; and

[7] *I* A previous U.S. Nuclear Regulatory Commission rule (10 CFR 20.304) authorized burial of small quantities of licensed materials in soil before January 28, 1981, without specific NRC authorization.

(3) A statement of disposition, or probable disposition, of the licensed or registered source of radiation involved; and

(4) Exposures of individuals to radiation, circumstances under which the exposures occurred, and the possible total effective dose equivalent to persons in unrestricted areas; and

(5) Actions that have been taken, or will be taken, to recover the source of radiation; and

(6) Procedures or measures that have been, or will be, adopted to ensure against a recurrence of the loss or theft of licensed or registered sources of radiation.

C. Subsequent to filing the written report, the licensee or registrant shall also report additional substantive information on the loss or theft within 30 days after the licensee or registrant learns of such information.

D. The licensee or registrant shall prepare any report filed with the Agency pursuant to D.51 so that names of individuals who may have received exposure to radiation are stated in a separate and detachable portion of the report.

52. Notification of Incidents.

A. Immediate Notification. Notwithstanding other requirements for notification, each licensee or registrant shall immediately report each event involving a source of radiation possessed by the licensee or registrant that may have caused or threatens to cause any of the following conditions:

(1) An individual to receive --

a. A total effective dose equivalent of 0.25 Sv (25 rem) or more; or

b. A lens dose equivalent of 0.75 Sv (75 rem) or more; or

c. A shallow-dose equivalent to the skin or extremities or a total organ dose equivalent of 2.5 Gy (250 rads) or more; or

(2) The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for 24 hours, the individual could have received an intake five times the occupational ALI. This provision does not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures).

B. Twenty-four hour Notification. Each licensee or registrant shall, within 24 hours of discovery of the event, report to the Agency each event involving loss of control of a licensed or registered source of radiation possessed by the licensee or registrant that may have caused, or threatens to cause, any of the following conditions:

(1) An individual to receive, in a period of 24 hours:

a. A total effective dose equivalent exceeding 0.05 Sv (5 rem); or

b. A lens dose equivalent exceeding 0.15 Sv (15 rem); or

c. A shallow-dose equivalent to the skin or extremities or a total organ dose equivalent exceeding 0.5 Sv (50 rem); or

(2) The release of radioactive material, inside or outside of a restricted area, so that, had an individual been present for 24 hours, the individual could have received an intake in excess of one occupational ALI. The provisions of this paragraph do not apply to locations where personnel are not normally stationed during routine operations, such as hot-cells or process enclosures.

C. The licensee or registrant shall prepare each report filed with the Agency pursuant to D.52 so that names of individuals who have received exposure to sources of radiation are stated in a separate and detachable portion of the report.

D. Licensees or registrants shall make the reports required by D.52.A and B to the Agency by telephone, telegram, mailgram, or facsimile to the Agency.

E. The provisions of D.52 do not apply to doses that result from planned special exposures, provided such doses are within the limits for planned special exposures and are reported pursuant to D.54.

53. Reports of Exposures, Radiation Levels, and Concentrations of Radioactive Material Exceeding the Limits.

A. Reportable Events. In addition to the notification required by D.52, each licensee or registrant shall submit a written report within 30 days after learning of any of the following occurrences:

(1) Incidents for which notification is required by D.52; or

(2) Doses in excess of any of the following:

a. The occupational dose limits for adults in D.6; or

b. The occupational dose limits for a minor in D.12; or

c. The limits for an embryo/fetus of a declared pregnant woman in D.13; or

d. The limits for an individual member of the public in D.14; or

e. Any applicable limit in the license or registration; or

(3) Levels of radiation or concentrations of radioactive material in:

a. A restricted area in excess of applicable limits in the license or registration; or

b. An unrestricted area in excess of 10 times the applicable limit set forth in Part D or in the license or registration, whether or not involving exposure of any individual in excess of the limits in D.14; or

(4) For licensees subject to the provisions of U.S. Environmental Protection Agency's generally applicable environmental radiation standards in 40 CFR 190, levels of radiation or releases of radioactive material in excess of those standards, or of license conditions related to those standards.

B. Contents of Reports.

(1) Each report required by D.53.A shall describe the extent of exposure of individuals to radiation and radioactive material, including, as appropriate:

a. Estimates of each individual's dose; and

b. The levels of radiation and concentrations of radioactive material involved; and

c. The cause of the elevated exposures, dose rates, or concentrations; and

d. Corrective steps taken or planned to ensure against a recurrence, including the schedule for achieving conformance with applicable limits, generally applicable environmental standards, and associated license or registration conditions.

(2) Each report filed pursuant to D.53.A. shall include for each individual exposed: the name, Social Security account number, and date of birth. With respect to the limit for the embryo/fetus in D.13, the identifiers should be those of the declared pregnant woman. The report shall be prepared so that this information is stated in a separate and detachable portion of the report.

C. All licensees or registrants who make reports pursuant to D.53.A shall submit the report in writing to the Agency.

54. Reports of Planned Special Exposures. The licensee or registrant shall submit a written report to the Agency within 30 days following any planned special exposure conducted in accordance with D.11, informing the Agency that a planned special exposure was conducted and indicating the date the planned special exposure occurred and the information required by Sec. D.45.

55. Reports to Individuals of exceeding dose limits. When a licensee is required, pursuant to D.53, D.54, or D.56 to report to the Agency any exposure of an identified occupationally exposed individual, or an identified member of the public, to radiation or radioactive material, the licensee shall also provide a copy of the report submitted to the Agency to the individual. This report must be transmitted at a time no later than the transmittal to the Agency.

56. Reports of Individual Monitoring.

A. This section applies to each person licensed or registered by the Agency to:

(1) Possess or use sources of radiation for purposes of industrial radiography pursuant to Parts C and E of these regulations; or

(2) Possess or use at any time, for processing or manufacturing for distribution pursuant to Part C or G of these regulations, radioactive material in quantities exceeding any one of the following quantities:

Radionuclide	Activity[a]	
	Ci	GBq
Cesium-137	1	37
Cobalt-60	1	37
Gold-198	100	3,700
Iodine-131	1	37
Iridium-192	10	370
Krypton-85	1,000	37,000
Promethium-147	10	370
Technetium- 99m	1,000	37,000.

[a] The Agency may require as a license condition, or by rule, regulation, or order, reports from licensees or registrants who are licensed or registered to use radionuclides not on this list, in quantities sufficient to cause comparable radiation levels.

B. Each licensee or registrant in a category listed in D.56.A shall submit an annual report of the results of individual monitoring carried out by the licensee or registrant for each individual for whom monitoring was required by D.18 during that year. The licensee or registrant may include additional data for individuals for whom monitoring was provided but not required. The licensee or registrant shall use HHE-840 or equivalent or electronic media containing all the information required by HHE-840.

C. The licensee or registrant shall file the report required by D.56.B, covering the preceding year, on or before April 30 of each year. The licensee or registrant shall submit the report to the Agency.

57. Notifications and Reports to Individuals.

A. Requirements for notification and reports to individuals of exposure to radiation or radioactive material are specified in J.4 of these regulations.

B. When a licensee or registrant is required pursuant to D.53 to report to the Agency any exposure of an individual to radiation or radioactive material, the licensee or registrant shall also notify the individual. Such notice shall be transmitted at a time not later than the transmittal to the Agency, and shall comply with the provisions of J.4.A of these regulations.

58. Reports of Leaking or Contaminated Sealed Sources. The licensee or registrant shall file a report within 5 days with the Agency if the test for leakage or contamination required pursuant to D.16. indicates a sealed source is leaking or contaminated. The report shall include the equipment involved, the test results and the corrective action taken.

ADDITIONAL REQUIREMENTS

59. Vacating Premises. Each specific licensee or registrant shall, no less than 30 days before vacating or relinquishing possession or control of premises which may have been contaminated with radioactive material as a result of his activities, notify the Agency in writing of intent to vacate. When deemed necessary by the Agency, the licensee shall decontaminate the premises in such a manner as the Agency may specify.

RADIOLOGICAL CRITERIA FOR LICENSE TERMINATION

60. General Provisions and Scope. The criteria in this subpart apply to the decommissioning of facilities licensed under Parts C, E , G and K of these regulations.

A. The criteria in this subpart do not apply to sites, which have been decommissioned prior to the effective date of this rule.

B. After a site has been decommissioned and the license terminated in accordance with the criteria in this subpart, the Agency will require additional cleanup only if, based on new information, it determines that the criteria of this subpart were not met and residual radioactivity remaining at the site could result in significant threat to public health and safety.

C. When calculating TEDE to the average member of the critical group the licensee shall determine the peak annual TEDE dose expected within the first 1000 years after decommissioning.

D. Specific time limits for the completing the decommissioning process.

(1) Licensees shall complete decommissioning of the site or separate building or outdoor area as soon as practicable but not later than 24 months following the initiation of decommissioning.

(2) When decommissioning involves the entire site, the licensee shall request license termination as soon as practicable but not later than 24 months following the initiation of decommissioning.

E. The Agency may approve a request for an alternative schedule for completion of the decommissioning of the site or separate building or outdoor area, and license termination is appropriate, if the Agency determines that the alternative is warranted.

61. Radiological Criteria for Unrestricted Use. A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that shall not exceed 10 mrem (0.10 mSv) per year, including that from groundwater sources of drinking water and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels, which are ALARA, must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal.

62. Criteria for License Termination Under Restricted Conditions. A site will be considered acceptable for license termination under restricted conditions if:

A. The licensee can demonstrate that further reductions in residual radioactivity necessary to comply with the provisions of D.61. would result in net public or environmental harm or were not being made because the residual levels associated with restricted conditions are ALARA. Determination of the levels, which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal;

B. The licensee has made provisions for legally enforceable institutional controls that provide reasonable assurance that TEDE from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 10 mrem (0.10 mSv) per year;

C. The licensee has provided sufficient financial assurance to enable an independent third party, including a governmental custodian of a site, to assume and carry out responsibilities for any necessary control and maintenance of the site. Acceptable financial assurance mechanisms are:

(1) Funds placed into an account segregated from the licensee's assets and outside the licensee's administrative control as described in Part C.8.F.

(2) Surety method, insurance, or other guarantee method as described in Part C.8.F.;

(3) A statement of intent in the case of State, or local Government licensees, as described in Part C.8.F.; or

(4) When a governmental entity is assuming custody and ownership of a site, an arrangement that is deemed acceptable by such governmental entity.

D. The licensee has submitted a decommissioning plan or License Termination Plan (LTP) to the Agency indicating the licensee's intent to decommission in accordance with Parts C, D, and E, and specifying that the licensee intends to decommission by restricting use of the site. The licensee shall document in the LTP or decommissioning plan how the advice of individuals and institutions in the community who may be affected by the decommissioning has been sought and incorporated, as appropriate , following analysis of that advice.

(1) Licensees proposing to decommission by restricting use of the site shall seek advice from such affected parties regarding the following matters concerning the proposed decommissioning:

a. Whether provisions for institutional controls proposed by the licensee:

(i) Will provide reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group will not exceed 10 mrem (0.10 mSv) TEDE per year;

(ii) Will be enforceable; and

(iii) Will not impose undue burdens on the local community or other affected parties.

b. Whether the licensee has provided sufficient financial assurance to enable a third party, including a governmental custodian of a site, to assume and carry out responsibilities for any necessary control and maintenance of the site;

(2) In seeking advice on the issues identified in 62.D.(1), the licensee shall provide for:

a. Participation by representatives of a broad cross section of community interests who may be affected by the decommissioning;

b. An opportunity for a comprehensive, collective discussion on the issues by the participants represented; and

c. A publicly available summary of the results of all such discussions, including a description of the individual viewpoints of the participants on the issues and the extent of agreement and disagreement among the participants on the issues; and

E. Residual radioactivity at the site has been reduced so that if the institutional controls were no longer in effect, there is reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group is as low as reasonably achievable and would not exceed either:

(1) 1mSv (100 mrem) per year; or

(2) 5MsV (500 mrem) per year provided the licensee:

a. Demonstrates that further reductions in residual radioactivity necessary to comply with the 100 mrem/yr (1 mSv/yr) value of paragraph E.(1) of this section are not technically achievable, would be prohibitively expensive, or would result in net public or environmental harm;

b. Makes provisions for durable institutional controls;

c. Provides sufficient financial assurance to enable a responsible government entity or independent third party, including a governmental custodian of a site, both to carry out periodic rechecks of the site no less frequently than every 3 years to assure that the institutional controls remain in place as necessary to meet the criteria of D.62.B. and to assume and carry out responsibilities for any necessary control and maintenance of those controls. Acceptable financial assurance mechanisms are those in paragraph C. of this section.

63. Alternate Criteria for License Termination

A. The Agency may terminate a license using alternate criteria greater than the dose criterion of parts D.61., D.62.B., and D.62.D., if the licensee:

(1) Provides assurance that public health and safety would continue to be protected, and that it is unlikely that the dose from all man-made sources combined, other than medical, would be more than the 1 mSv/y (100 mrem/y) limit, by submitting an analysis of possible sources of exposure;

(2) Has employed to the extent practical restrictions on the site use according to the provisions of D.62. in minimizing exposures at the site; and

(3) Reduces doses to ALARA levels, taking into consideration any detriments such as traffic accidents expected to potentially result from decontamination and waste disposal.

(4) Has submitted a decommissioning plan or License Termination Plan (LTP) to the Agency indicating the licensee's intent to decommission in accordance with Parts C, D, and E., and specifying that the licensee proposes to decommission by use of alternate criteria. The licensee shall document in the decommissioning plan or LTP how the advice of individuals and institutions in the community who may be affected by the decommissioning has been sought and addressed, as appropriate, following analysis of that advice. In seeking such advice, the license shall provide for:

a. Participation by representatives of a broad cross section of community interests who may be affected by the decommissioning;

b. An opportunity for a comprehensive, collective discussion on the issues by the participants represented; and

c. A publicly available summary of the results of all such discussions, including a description of the individual viewpoints of the participants on the issues and the extent of agreement and disagreement among the participants on the issues

B. The use of alternate criteria to terminate a license requires the approval of the Agency after consideration of the Agency's staff's recommendations that will address any comments by other appropriate agencies and any public comments submitted pursuant to D. 64.

64. Public Notification and Public Participation. Upon the receipt of an LTP or decommissioning plan from the licensee, or a proposal by the licensee for release of a site pursuant to D.62. and D.63., or whenever the Agency deems such notice to be in the public interest, the Agency shall:

A. Notify and solicit comments from:

(1) Local governments in the vicinity of the site and any Indian Nation or other indigenous people that have treaty or statutory rights that could be affected by the decommissioning; and

(2) Other appropriate agencies for cases where the licensee proposes to release a site pursuant to D.63.

B. Publish a notice in a forum, such as local newspapers, letters to State or local organizations, or other appropriate forum, that is readily accessible to individuals in the vicinity of the site, and solicit comments from affected parties.

65. Minimization of Contamination. Applicants for licenses, after July 1, 1999, shall describe in the application how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste..

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APPENDIX A

ASSIGNED PROTECTION FACTORS FOR RESPIRATOR [A]

		Operating Mode	Assigned Protection Factors	
	I. Air purifying respirators (Particulate[b] only)[c]			
	Filtering faceplate disposable[d] ----------	Negative Pressure----------	([d])	
	Facepiece, half[e]----------	Negative Pressure----------	10	
	Facepiece, full----------	Negative Pressure----------	100	
	Facepiece, half----------	Powered air-purifying	50	
	Facepiece, full----------	respirators-	1000	
	Helmet/hood----------	Powered air-purifying	1000	
	Facepiece, loose fitting----------	respirators-	25	
	--	Powered air-purifying respirators-		
		Powered air-purifying respirators-		
	II. Atmosphere supplying respirators (Particulate, gases, and vapors[f])			
	1: Air-line respirator:			
	Facepiece, half----------	Demand----------	10	
	Facepiece, half[e]----------	Continuous Flow----------	50	
	Facepiece, half----------	Pressure Demand----------	50	
	Facepiece, full----------	Demand----------	100	
	Facepiece, full----------	Continuous Flow----------	1000	
	Facepiece, full----------	Pressure Demand----------	1000	
	Helmet/hood----------	Continuous Flow----------	1000	
	Facepiece, loose fitting----------	Continuous Flow----------	25	
	-	Continuous Flow----------	([g])	
	Suit----------			
	2: Self-contained breathing apparatus (SCBA):	Demand----------	[h]100	
	Facepiece, full----------	Pressure Demand----------	[i]10,000	
	Facepiece, full----------	Demand, recirculating----------	[h]100	
	Facepiece, full----------	Positive Pressure	[i]10,000	
	Facepiece, full----------	Recirculating---		
	III.Combination respirators: Any combination of air-purifying and atmosphere-supplying respirators	Assigned protection factor for type and mode of operations as listed above		

See the following pages for footnotes.

a. These assigned protection factors apply only in respiratory protection program that meets the requirements of this Part. They are applicable only to airborne radiological hazards and may not be appropriate to circumstances when chemical or other respiratory hazards exist instead of, or in addition to, radioactive hazards. Selection and use of respirators for such circumstances must also comply with Department of Labor regulations.

   Radioactive contaminants for which the concentration values in Table 1, column 3 of Appendix B to Part D are based on internal dose due to inhalation may, in addition, present external exposure hazards at higher concentrations. Under these circumstances, limitations on occupancy may have to be governed by external dose limits.

b. Air purifying respirators with APF <100 must be equipped with particulate filters that are at least 95 percent efficient. Air purifying respirators with APF =100 must be equipped with particulate filters that area t least 99 percent efficient. Air purifying respirators with APF >100 must be equipped with particulate filters that area t least 99.97 percent efficient.

c. The licensee may apply to the Agency for the use of an APF greater than 1 for sorbent cartridges as protection against airborne radioactive gases and vapors (e.g., radioiodine).

d. Licensees may permit individuals to use this type of respirator who have not been medically screened or fit tested on the device provided that no credit be taken for their use in estimating intake or dose. It is also recognized that it is difficult to perform an effective positive or negative pressure pre-use user seal check on this type of device. All other respiratory protection program requirements listed in D.24 apply. An assigned protection factor has not been assigned for these devices. However, an APF equal to 10 may be used if the licensee can demonstrate a fit factor of at least 100 by use of a validated or evaluated, qualitative or quantitative fit test.

e. Under-chin type only. No distinction is made in this Appendix between elastomeric half-masks with replaceable cartridges and those designed with the filter medium as an integral part of the facepiece (e.g., disposable or reusable disposable). Both types are acceptable so long as the seal area of the latter contains some substantial type of seal enhancing material such as rubber or plastic, the two or more suspension straps are adjustable, the filter medium is at least 95 percent efficient and all other requirements of this Part are met.

f. The assigned protection factors for gases and vapors are not applicable to radioactive contaminants that present an absorption or submersion hazard. For tritium oxide vapor, approximately one0third of the intake occurs by absorption through the skin so that an overall protection factor of 3 is appropriate when atmosphere-supplying respirators are used to protect against tritium oxide. Exposure to radioactive noble gases is not considered a significant respiratory hazard, and protective actions for these contaminants should be based on external (submersion) dose considerations.

g. No NIOSH approval schedule is currently available for atmospheric supplying units. This equipment may be used in an acceptable respiratory protection program as long as all the other minimum program requirements, with the exception of fit testing, are met (i.e., D.24).

h. The licensee should implement institutional controls to assure that these devices are not used in areas immediately dangerous to life or health (IDLH).

i. This type of respirator may be used as an emergency device in unknown concentrations for protection against inhalation hazards. External radiation hazards and other limitations to permitted exposure such as skin absorption shall be taken into account in these circumstances. This device may not be used by any individual who experiences perceptible outward leakage of breathing gas while wearing the device.

APPENDIX B

ANNUAL LIMITS ON INTAKE (ALI) AND DERIVED AIR CONCENTRATIONS (DAC) OF RADIONUCLIDES FOR OCCUPATIONAL EXPOSURE; EFFLUENT CONCENTRATIONS; CONCENTRATIONS FOR RELEASE TO SANITARY SEWERAGE

1. Introduction

For each radionuclide, Table I indicates the chemical form which is to be used for selecting the appropriate ALI or DAC value. The ALIs and DACs for inhalation are given for an aerosol with an activity median aerodynamic diameter (AMAD) of 1 mm, micron, and for three classes (D,W,Y) of radioactive material, which refer to their retention (approximately days, weeks or years) in the pulmonary region of the lung. This classification applies to a range of clearance half-times for D if less than 10 days, for W from 10 to 100 days, and for Y greater than 100 days. Table II provides concentration limits for airborne and liquid effluents released to the general environment. Table III provides concentration limits for discharges to sanitary sewerage.

Note: The values in Tables I, II, and III are presented in the computer "E" notation. In this notation a value of 6E-02 represents a value of 6 x 10^{-2} or 0.06, 6E+2 represents 6 x 10^{2} or 600, and 6E+0 represents 6 x 100 or 6.

2. Table I "Occupational Values"

Note that the columns in Table I of this appendix captioned "Oral Ingestion ALI," "Inhalation ALI," and "DAC," are applicable to occupational exposure to radioactive material.

The ALIs in this appendix are the annual intakes of given radionuclide by "Reference Man" which would result in either (1) a committed effective dose equivalent of 0.05 Sv (5 rem), stochastic ALI, or (2) a committed dose equivalent of 0.5 Sv (50 rem) to an organ or tissue, non-stochastic ALI. The stochastic ALIs were derived to result in a risk, due to irradiation of organs and tissues, comparable to the risk associated with deep dose equivalent to the whole body of 0.05 Sv (5 rem). The derivation includes multiplying the committed dose equivalent to an organ or tissue by a weighting factor, w_T. This weighting factor is the proportion of the risk of stochastic effects resulting from irradiation of the organ or tissue, T, to the total risk of stochastic effects when the whole body is irradiated uniformly. The values of w_T are listed under the definition of weighting factor in D.3. The non-stochastic ALIs were derived to avoid non-stochastic effects, such as prompt damage to tissue or reduction in organ function.

A value of w_T = 0.06 is applicable to each of the five organs or tissues in the "remainder" category receiving the highest dose equivalents, and the dose equivalents of all other remaining tissues may be disregarded. The following portions of the GI tract, stomach, small intestine, upper large intestine, and lower large intestine, are to be treated as four separate organs.

Note that the dose equivalents for an extremity, skin and lens of the eye are not considered in computing the committed effective dose equivalent, but are subject to limits that must be met separately.

When an ALI is defined by the stochastic dose limit, this value alone is given. When an ALI is determined by the non-stochastic dose limit to an organ, the organ or tissue to which the limit applies is shown, and the ALI for the stochastic limit is shown in parentheses. Abbreviated organ or tissue designations are used:

LLI wall = lower large intestine wall;
St. wall = stomach wall;
Blad wall = bladder wall; and
Bone surf = bone surface.

The use of the ALIs listed first, the more limiting of the stochastic and non-stochastic ALIs, will ensure that non-stochastic effects are avoided and that the risk of stochastic effects is limited to an acceptably low value. If, in a particular situation involving a radionuclide for which the non-stochastic ALI is limiting, use of that non-stochastic ALI is considered unduly conservative, the licensee may use the stochastic ALI to determine the committed effective dose equivalent. However, the licensee shall also ensure that the 0.5 Sv (50 rem) dose equivalent limit for any organ or tissue is not exceeded by the sum of the external deep dose equivalent plus the internal committed dose equivalent to that organ, not the effective dose. For the case where there is no external dose contribution, this would be demonstrated if the sum of the fractions of the non-stochastic ALIs (ALI_{ns}) that contribute to the committed dose equivalent to the organ receiving the highest dose does not exceed unity, that is, (intake (in Ci) of each radionuclide/ALI_{ns}) $\leq$ 1.0. If there is an external deep dose equivalent contribution of H_d, then this sum must be less than 1 - (H_d/50), instead of $\leq$ 1.0.

Note that the dose equivalents for an extremity, skin, and lens of the eye are not considered in computing the committed effective dose equivalent, but are subject to limits that must be met separately.

The derived air concentration (DAC) values are derived limits intended to control chronic occupational exposures. The relationship between the DAC and the ALI is given by:

DAC = ALI(in mCi)/(2000 hours per working year x 60 minutes/hour x 2 x 10^4 ml per minute) = [ALI/2.4 x 10^9] mCi/ml, where 2 x 10^4 ml is the volume of air breathed per minute at work by Reference Man under working conditions of light work.

The DAC values relate to one of two modes of exposure: either external submersion or the internal committed dose equivalents resulting from inhalation of radioactive materials. DACs based upon submersion are for immersion in a semi-infinite cloud of uniform concentration and apply to each radionuclide separately.

The ALI and DAC values include contributions to exposure by the single radionuclide named and any in-growth of daughter radionuclides produced in the body by decay of the parent. However, intakes that include both the parent and daughter radionuclides should be treated by the general method appropriate for mixtures.

The values of ALI and DAC do not apply directly when the individual both ingests and inhales a radionuclide, when the individual is exposed to a mixture of radionuclides by either inhalation or ingestion or both, or when the individual is exposed to both internal and external irradiation. See D.7. When an individual is exposed to radioactive materials, which fall under several of the translocation classifications of the same radionuclide, such as, Class D, Class W, or Class Y, the exposure may be evaluated as if it were a mixture of different radionuclides.

It should be noted that the classification of a compound as Class D, W, or Y is based on the chemical form of the compound and does not take into account the radiological half-life of different radionuclides. For this reason, values are given for Class D, W, and Y compounds, even for very short-lived radionuclides.

3. Table II "Effluent Concentrations"

The columns in Table II of this appendix captioned "Effluents," "Air" and "Water" are applicable to the assessment and control of dose to the public, particularly in the implementation of the provisions of D.15. The concentration values given in Columns 1 and 2 of Table II are equivalent to the radionuclide concentrations which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.5 mSv (0.05 rem).

Consideration of non-stochastic limits has not been included in deriving the air and water effluent concentration limits because non-stochastic effects are presumed not to occur at or below the dose levels established for individual members of the public. For radionuclides, where the non-stochastic limit was governing in deriving the occupational DAC, the stochastic ALI was used in deriving the corresponding airborne effluent limit in Table II. For this reason, the DAC and airborne effluent limits are not always proportional.

The air concentration values listed in Table II, Column 1 were derived by one of two methods. For those radionuclides for which the stochastic limit is governing, the occupational stochastic inhalation ALI was divided by 2.4×10^9, relating the inhalation ALI to the DAC, as explained above, and then divided by a factor of 300. The factor of 300 includes the following components: a factor of 50 to relate the 0.05 Sv (5 rem) annual occupational dose limit to the 1 mSv (0.1 rem) limit for members of the public, a factor of 3 to adjust for the difference in exposure time and the inhalation rate for a worker and that for members of the public; and a factor of 2 to adjust the occupational values, derived for adults, so that they are applicable to other age groups.

For those radionuclides for which submersion, that is external dose, is limiting, the occupational DAC in Table I, Column 3 was divided by 219. The factor of 219 is composed of a factor of 50, as described above, and a factor of 4.38 relating occupational exposure for 2,000 hours per year to full-time exposure (8,760 hours per year). Note that an additional factor of 2 for age considerations is not warranted in the submersion case.

The water concentrations were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3×10^7. The factor of 7.3×10^7 (ml) includes the following components: the factors of 50 and 2 described above and a factor of 7.3×10^5 (ml), which is the annual water intake of Reference Man.

Note 2 of this appendix provides groupings of radionuclides, which are applicable to unknown mixtures of radionuclides. These groupings, including occupational inhalation ALIs and DACs, air and water effluent concentrations and releases to sewer, require demonstrating that the most limiting radionuclides in successive classes are absent. The limit for the unknown mixture is defined when the presence of one of the listed radionuclides cannot be definitely excluded as being present either from knowledge of the radionuclide composition of the source or from actual measurements.

4. Table III "Releases to Sewers"

The monthly average concentrations for release to sanitary sewerage are applicable to the provisions in D.35. The concentration values were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by 7.3×10^6 (ml). The factor of 7.3×10^6 (ml) is composed of a factor of 7.3×10^5 (ml), the annual water intake by Reference Man, and a factor of 10, such that the concentrations, if the sewage released by the licensee were the only source of water ingested by a Reference Man during a year, would result in a committed effective dose equivalent of 5 mSv (0.5 rem).

LIST OF ELEMENTS

Name	Symbol	Atomic Number	Name	Symbol	Atomic Number
Actinium	Ac	89	Mercury	Hg	80
Aluminum	Al	13	Molybdenum	Mo	42
Americium	Am	95	Neodymium	Nd	60
Antimony	Sb	51	Neptunium	Np	93
Argon	Ar	18	Nickel	Ni	28
Arsenic	As	33	Niobium	Nb	41
Astatine	At	85	Osmium	Os	76
Barium	Ba	56	Palladium	Pd	46
Berkelium	Bk	97	Phosphorus	P	15
Beryllium	Be	4	Platinum	Pt	78
Bismuth	Bi	83	Plutonium	Pu	94
Bromine	Br	35	Polonium	Po	84
Cadmium	Cd	48	Potassium	K	19
Calcium	Ca	20	Praseodymium	Pr	59
Californium	Cf	98	Promethium	Pm	61
Carbon	C	6	Protactinium	Pa	91
Cerium	Ce	58	Radium	Ra	88
Cesium	Cs	55	Radon	Rn	86
Chlorine	Cl	17	Rhenium	Re	75
Chromium	Cr	24	Rhodium	Rh	45
Cobalt	Co	27	Rubidium	Rb	37
Copper	Cu	29	Ruthenium	Ru	44
Curium	Cm	96	Samarium	Sm	62
Dysprosium	Dy	66	Scandium	Sc	21
Einsteinium	Es	99	Selenium	Se	34
Erbium	Er	68	Silicon	Si	14
Europium	Eu	63	Silver	Ag	47
Fermium	Fm	100	Sodium	Na	11
Fluorine	F	9	Strontium	Sr	38
Francium	Fr	87	Sulfur	S	16
Gadolinium	Gd	64	Tantalum	Ta	73
Gallium	Ga	31	Technetium	Tc	43
Germanium	Ge	32	Tellurium	Te	52
Gold	Au	79	Terbium	Tb	65
Hafnium	Hf	72	Thallium	Tl	81
Holmium	Ho	67	Thorium	Th	90
Hydrogen	H	1	Thulium	Tm	69
Indium	In	49	Tin	Sn	50
Iodine	I	53	Titanium	Ti	22
Iridium	Ir	77	Tungsten	W	74
Iron	Fe	26	Uranium	U	92
Krypton	Kr	36	Vanadium	V	23
Lanthanum	La	57	Xenon	Xe	54
Lead	Pb	82	Ytterbium	Yb	70
Lutetium	Lu	71	Yttrium	Y	39
Magnesium	Mg	12	Zinc	Zn	30
Manganese	Mn	25	Zirconium	Zr	40
Mendelevium	Md	101			

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
1	Hydrogen-3	Water, DAC includes skin absorption	8E+4	8E+4	2E-5	1E-7	1E-3	1E-2
		Gas (HT or T2) Submersion1: Use above values as HT and T_2 oxidize in air and in the body to HTO.						
4	Beryllium-7	W, all compounds except those given for Y	4E+4	2E+4	9E-6	3E-8	6E-4	6E-3
		Y, oxides, halides, and nitrates	-	2E+4	8E-6	3E-8	-	-
4	Beryllium-10	W, see 7Be	1E+3	2E+2	6E-8	2E-10	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see 7Be	-	1E+1	6E-9	2E-11	-	-
6	Carbon-11[2]	Monoxide	-	1E+6	5E-4	2E-6	-	-
		Dioxide	-	6E+5	3E-4	9E-7	-	-
		Compounds	4E+5	4E+5	2E-4	6E-7	6E-3	6E-2
6	Carbon-14	Monoxide	-	2E+6	7E-4	2E-6	-	-
		Dioxide	-	2E+5	9E-5	3E-7	-	-
		Compounds	2E+3	2E+3	1E-6	3E-9	3E-5	3E-4
9	Fluorine-18[2]	D, fluorides of H, Li, Na, K, Rb, Cs, and Fr	5E+4	7E+4	3E-5	1E-7	-	-
			St wall (5E+4)	-	-	-	7E-4	7E-3
		W, fluorides of Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, As, Sb, Bi, Fe, Ru, Os, Co, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, V, Nb, Ta, Mn, Tc, and Re	-	9E+4	4E-5	1E-7	-	-
		Y, lanthanum fluoride	-	8E+4	3E-5	1E-7	-	-
11	Sodium-22	D, all compounds	4E+2	6E+2	3E-7	9E-10	6E-6	6E-5
11	Sodium-24	D, all compounds	4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
12	Magnesium-28	D, all compounds except those given for W	7E+2	2E+3	7E-7	2E-9	9E-6	9E-5
		W, oxides, hydroxides, carbides, halides, and nitrates	-	1E+3	5E-7	2E-9	-	-
13	Aluminum-26	D, all compounds except those given for W	4E+2	6E+1	3E-8	9E-11	6E-6	6E-5
		W, oxides, hydroxides, carbides, halides, and nitrates	-	9E+1	4E-8	1E-10	-	-
14	Silicon-31	D, all compounds except those given for W and Y	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
		W, oxides, hydroxides, carbides, and nitrates	-	3E+4	1E-5	5E-8	-	-
		Y, aluminosilicate glass	-	3E+4	1E-5	4E-8	-	-
14	Silicon-32	D, see 31Si	2E+3	2E+2	1E-7	3E-10	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
		W, see 31Si	-	1E+2	5E-8	2E-10	-	-
		Y, see 31Si	-	5E+0	2E-9	7E-12	-	-
15	Phosphorus-32	D, all compounds except phosphates given for W	6E+2	9E+2	4E-7	1E-9	9E-6	9E-5
		W, phosphates of Zn2+, S3+, Mg2+, Fe3+, Bi3+, and lanthanides	-	4E+2	2E-7	5E-10	-	-
15	Phosphorus-33	D, see 32P	6E+3	8E+3	4E-6	1E-8	8E-5	8E-4
		W, see 32P	-	3E+3	1E-6	4E-9	-	-
16	Sulfur-35	Vapor	1E+4	6E-6	2E-8	-	-	
		D, sulfides and sulfates except those given for W	1E+4	2E+4	7E-6	2E-8	-	-
			LLI wall (8E+3)	-	-	-	1E-4	1E-3
		W, elemental sulfur, sulfides of Sr, Ba, Ge, Sn, Pb, As, Sb, Bi, Cu, Ag, Au, Zn, Cd, Hg, W, and Mo. Sulfates of Ca, Sr, Ba, Ra, As, Sb, and Bi	6E+3	-	2E+3	9E-7	3E-9	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
17	Chlorine-36	D, chlorides of H, Li, Na, K, Rb, Cs, and Fr	2E+3	2E+3	1E-6	3E-9	2E-5	2E-4
		W, chlorides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Tc, and Re	-	2E+2	1E-7	3E-10	-	-
17	Chlorine-38[2]	D, see 36Cl	2E+4	4E+4	2E-5	6E-8	-	-
			St wall (3E+4)	-	-	-	3E-4	3E-3
		W, see 36Cl	-	5E+4	2E-5	6E-8	-	-
17	Chlorine-39[2]	D, see 36Cl	2E+4	5E+4	2E-5	7E-8	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
		W, see 36Cl	-	6E+4	2E-5	8E-8	-	-
18	Argon-37	Submersion1	-	-	1E+0	6E-3	-	-
18	Argon-39	Submersion1	-	-	2E-4	8E-7	-	-
18	Argon-41	Submersion1	-	-	3E-6	1E-8	-	-
19	Potassium-40	D, all compounds	3E+2	4E+2	2E-7	6E-10	4E-6	4E-5
19	Potassium-42	D, all compounds	5E+3	5E+3	2E-6	7E-9	6E-5	6E-4
19	Potassium-43	D, all compounds	6E+3	9E+3	4E-6	1E-8	9E-5	9E-4
19	Potassium-44[2]	D, all compounds	2E+4	7E+4	3E-5	9E-8	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
19	Potassium-45[2]	D, all compounds	3E+4	1E+5	5E-5	2E-7	-	-
			St wall (5E+4)	-	-	-	7E-4	7E-3
20	Calcium-41	W, all compounds	3E+3	4E+3	2E-6	-	-	-
			Bone surf (4E+3)	Bone surf (4E+3)	-	5E-9	6E-5	6E-4
20	Calcium-45	W, all compounds	2E+3	8E+2	4E-7	1E-9	2E-5	2E-4
20	Calcium-47	W, all compounds	8E+2	9E+2	4E-7	1E-9	1E-5	1E-4
21	Scandium-43	Y, all compounds	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
21	Scandium-44m	Y, all compounds	5E+2	7E+2	3E-7	1E-9	7E-6	7E-5
21	Scandium-44	Y, all compounds	4E+3	1E+4	5E-6	2E-8	5E-5	5E-4
21	Scandium-46	Y, all compounds	9E+2	2E+2	1E-7	3E-10	1E-5	1E-4
21	Scandium-47	Y, all compounds	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
21	Scandium-48	Y, all compounds	8E+2	1E+3	6E-7	2E-9	1E-5	1E-4
21	Scandium-49[2]	Y, all compounds	2E+4	5E+4	2E-5	8E-8	3E-4	3E-3
22	Titanium-44	D, all compounds except those given for W and Y	3E+2	1E+1	5E-9	2E-11	4E-6	4E-5
		W, oxides, hydroxides, carbides, halides, and nitrates	-	3E+1	1E-8	4E-11	-	-
		Y, SrTi0	-	6E+0	2E-9	8E-12	-	-
22	Titanium-45	D, see 44Ti	9E+3	3E+4	1E-5	3E-8	1E-4	1E-3
		W, see 44Ti	-	4E+4	1E-5	5E-8	-	-
		Y, see 44Ti	-	3E+4	1E-5	4E-8	-	-
23	Vanadium-47[2]	D, all compounds except those given for W	3E+4	8E+4	3E-5	1E-7	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		W, oxides, hydroxides, carbides, and halides	-	1E+5	4E-5	1E-7	-	-
23	Vanadium-48	D, see 47V	6E+2	1E+3	5E-7	2E-9	9E-6	9E-5
		W, see 47V	-	6E+2	3E-7	9E-10	-	-
23	Vanadium-49	D, see 47V	7E+4	3E+4	1E-5	-	-	-
			LLI wall (9E+4)	Bone surf (3E+4)	-	5E-8	1E-3	1E-2
		W, see 47V	-	2E+4	8E-6	2E-8	-	-
24	Chromium-48	D, all compounds except those given for W and Y	6E+3	1E+4	5E-6	2E-8	8E-5	8E-4
		W, halides and nitrates	-	7E+3	3E-6	1E-8	-	-
		Y, oxides and hydroxides	-	7E+3	3E-6	1E-8	-	-
24	Chromium-49[2]	D, see 48Cr	3E+4	8E+4	4E-5	1E-7	4E-4	4E-3
		W, see 48Cr	-	1E+5	4E-5	1E-7	-	-
		Y, see 48Cr	-	9E+4	4E-5	1E-7	-	-
24	Chromium-51	D, see 48Cr	4E+4	5E+4	2E-5	6E-8	5E-4	5E-3
		W, see 48Cr	-	2E+4	1E-5	3E-8	-	-
		Y, see 48Cr	-	2E+4	8E-6	3E-8	-	-
25	Manganese-51[2]	D, all compounds except those given for W	2E+4	5E+4	2E-5	7E-8	3E-4	3E-3
		W, oxides, hydroxides, halides, and nitrates	-	6E+4	3E-5	8E-8	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
25	Manganese-52m[2]	D, see 51Mn	3E+4	9E+4	4E-5	1E-7	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
		W, see 51Mn	-	1E+5	4E-5	1E-7	-	-
25	Manganese-52	D, see 51Mn	7E+2	1E+3	5E-7	2E-9	1E-5	1E-4
		W, see 51Mn	-	9E+2	4E-7	1E-9	-	-
25	Manganese-53	D, see 51Mn	5E+4	1E+4	5E-6	-	7E-4	7E-3
			-	Bone surf (2E+4)	-	3E-8	-	-
		W, see 51Mn	-	1E+4	5E-6	2E-8	-	-
25	Manganese-54	D, see 51Mn	2E+3	9E+2	4E-7	1E-9	3E-5	3E-4
		W, see 51Mn	-	8E+2	3E-7	1E-9	-	-
25	Manganese-56	D, see 51Mn	5E+3	2E+4	6E-6	2E-8	7E-5	7E-4
		W, see 51Mn	-	2E+4	9E-6	3E-8	-	-
26	Iron-52	D, all compounds except those given for W	9E+2	3E+3	1E-6	4E-9	1E-5	1E-4
		W, oxides, hydroxides, and halides	-	2E+3	1E-6	3E-9	-	-
26	Iron-55	D, see 52Fe	9E+3	2E+3	8E-7	3E-9	1E-4	1E-3
		W, see 52Fe	-	4E+3	2E-6	6E-9	-	-
26	Iron-59	D, see 52Fe	8E+2	3E+2	1E-7	5E-10	1E-5	1E-4
		W, see 52Fe	-	5E+2	2E-7	7E-10	-	-
26	Iron-60	D, see 52Fe	3E+1	6E+0	3E-9	9E-12	4E-7	4E-6
		W, see 52Fe	-	2E+1	8E-9	3E-11	-	-
27	Cobalt-55	W, all compounds except those given for Y	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		Y, oxides, hydroxides, halides, and nitrates	-	3E+3	1E-6	4E-9	-	-
27	Cobalt-56	W, see 55Co	5E+2	3E+2	1E-7	4E-10	6E-6	6E-5
		Y, see 55Co	4E+2	2E+2	8E-8	3E-10	-	-
27	Cobalt-57	W, see 55Co	8E+3	3E+3	1E-6	4E-9	6E-5	6E-4
		Y, see 55Co	4E+3	7E+2	3E-7	9E-10	-	-
27	Cobalt-58m	W, see 55Co	6E+4	9E+4	4E-5	1E-7	8E-4	8E-3
		Y, see 55Co	-	6E+4	3E-5	9E-8	-	-
27	Cobalt-58	W, see 55Co	2E+3	1E+3	5E-7	2E-9	2E-5	2E-4
		Y, see 55Co	1E+3	7E+2	3E-7	1E-9	-	-
27	Cobalt-60m[2]	W, see 55Co	1E+6	4E+6	2E-3	6E-6	-	-
			St wall (1E+6)	-	-	-	2E-2	2E-1
		Y, see 55Co	-	3E+6	1E-3	4E-6	-	-
27	Cobalt-60	W, see 55Co	5E+2	2E+2	7E-8	2E-10	3E-6	3E-5
		Y, see 55Co	2E+2	3E+1	1E-8	5E-11	-	-
27	Cobalt-612	W, see 55Co	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		Y, see 55Co	2E+4	6E+4	2E-5	8E-8	-	-
27	Cobalt-62m[2]	W, see 55Co	4E+4	2E+5	7E-5	2E-7	-	-
			St wall (5E+4)	-	-	-	7E-4	7E-3
		Y, see 55Co	-	2E+5	6E-5	2E-7	-	-
28	Nickel-56	D, all compounds except those given for W	1E+3	2E+3	8E-7	3E-9	2E-5	2E-4
		W, oxides, hydroxides, and carbides	-	1E+3	5E-7	2E-9	-	-
		Vapor	-	1E+3	5E-7	2E-9	-	-
28	Nickel-57	D, see 56Ni	2E+3	5E+3	2E-6	7E-9	2E-5	2E-4
		W, see 56Ni	-	3E+3	1E-6	4E-9	-	-
		Vapor	-	6E+3	3E-6	9E-9	-	-
28	Nickel-59	D, see 56Ni	2E+4	4E+3	2E-6	5E-9	3E-4	3E-3
		W, see 56Ni	-	7E+3	3E-6	1E-8	-	-
		Vapor	-	2E+3	8E-7	3E-9	-	-
28	Nickel-63	D, see 56Ni	9E+3	2E+3	7E-7	2E-9	1E-4	1E-3
		W, see 56Ni	-	3E+3	1E-6	4E-9	-	-
		Vapor	-	8E+2	3E-7	1E-9	-	-
28	Nickel-65	D, see 56Ni	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3
		W, see 56Ni	-	3E+4	1E-5	4E-8	-	-
		Vapor	-	2E+4	7E-6	2E-8	-	-
28	Nickel-66	D, see 56Ni	4E+2	2E+3	7E-7	2E-9	-	-
			LLI wall (5E+2)	-	-	-	6E-6	6E-5
		W, see 56Ni	-	6E+2	3E-7	9E-10	-	-
		Vapor	-	3E+3	1E-6	4E-9	-	-
29	Copper-60[2]	D, all compounds except those given for W and Y	3E+4	9E+4	4E-5	1E-7	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		W, sulfides, halides, and nitrates	-	1E+5	5E-5	2E-7	-	-
		Y, oxides and hydroxides	-	1E+5	4E-5	1E-7	-	-
29	Copper-61	D, see 60Cu	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see 60Cu	-	4E+4	2E-5	6E-8	-	-
		Y, see 60Cu	-	4E+4	1E-5	5E-8	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table I Occupational Values Col. 2 Inhalation ALI (μCi)	Table I Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Table II Effluent Concentrations Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
29	Copper-64	D, see 60Cu	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see 60Cu	-	2E+4	1E-5	3E-8	-	-
		Y, see 60Cu	-	2E+4	9E-6	3E-8	-	-
29	Copper-67	D, see 60Cu	5E+3	8E+3	3E-6	1E-8	6E-5	6E-4
		W, see 60Cu	-	5E+3	2E-6	7E-9	-	-
		Y, see 60Cu	-	5E+3	2E-6	6E-9	-	-
30	Zinc-62	Y, all compounds	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
30	Zinc-63[2]	Y, all compounds	2E+4	7E+4	3E-5	9E-8	-	-
			St wall (3E+4)	-	-	-	3E-4	3E-3
30	Zinc-65	Y, all compounds	4E+2	3E+2	1E-7	4E-10	5E-6	5E-5
30	Zinc-69m	Y, all compounds	4E+3	7E+3	3E-6	1E-8	6E-5	6E-4
30	Zinc-69[2]	Y, all compounds	6E+4	1E+5	6E-5	2E-7	8E-4	8E-3
30	Zinc-71m	Y, all compounds	6E+3	2E+4	7E-6	2E-8	8E-5	8E-4
30	Zinc-72	Y, all compounds	1E+3	1E+3	5E-7	2E-9	1E-5	1E-4
31	Gallium-65[2]	D, all compounds except those given for W	5E+4	2E+5	7E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	9E-4	9E-3
		W, oxides, hydroxides, carbides, halides, and nitrates	-	2E+5	8E-5	3E-7	-	-
31	Gallium-66	D, see 65Ga	1E+3	4E+3	1E-6	5E-9	1E-5	1E-4
		W, see 65Ga	-	3E+3	1E-6	4E-9	-	-
31	Gallium-67	D, see 65Ga	7E+3	1E+4	6E-6	2E-8	1E-4	1E-3
		W, see 65Ga	-	1E+4	4E-6	1E-8	-	-
31	Gallium-68[2]	D, see 65Ga	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see 65Ga	-	5E+4	2E-5	7E-8	-	-
31	Gallium-70[2]	D, see 65Ga	5E+4	2E+5	7E-5	2E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
		W, see 65Ga	-	2E+5	8E-5	3E-7	-	-
31	Gallium-72	D, see 65Ga	1E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		W, see 65Ga	-	3E+3	1E-6	4E-9	-	-
31	Gallium-73	D, see 65Ga	5E+3	2E+4	6E-6	2E-8	7E-5	7E-4
		W, see 65Ga	-	2E+4	6E-6	2E-8	-	-
32	Germanium-66	D, all compounds except those given for W	2E+4	3E+4	1E-5	4E-8	3E-4	3E-3
		W, oxides, sulfides, and halides	-	2E+4	8E-6	3E-8	-	-
32	Germanium-67[2]	D, see 66Ge	3E+4	9E+4	4E-5	1E-7	-	-
			St wall (4E+4)	-	-	-	6E-4	6E-3
		W, see 66Ge	-	1E+5	4E-5	1E-7	-	-
32	Germanium-68	D, see 66Ge	5E+3	4E+3	2E-6	5E-9	6E-5	6E-4
		W, see 66Ge	-	1E+2	4E-8	1E-10	-	-
32	Germanium-69	D, see 66Ge	1E+4	2E+4	6E-6	2E-8	2E-4	2E-3
		W, see 66Ge	-	8E+3	3E-6	1E-8	-	-
32	Germanium-71	D, see 66Ge	5E+5	4E+5	2E-4	6E-7	7E-3	7E-2
		W, see 66Ge	-	4E+4	2E-5	6E-8	-	-
32	Germanium-75[2]	D, see 66Ge	4E+4	8E+4	3E-5	1E-7	-	-
			St wall (7E+4)	-	-	-	9E-4	9E-3
		W, see 66Ge	-	8E+4	4E-5	1E-7	-	-
32	Germanium-77	D, see 66Ge	9E+3	1E+4	4E-6	1E-8	1E-4	1E-3
		W, see 66Ge	-	6E+3	2E-6	8E-9	-	-
32	Germanium-78[2]	D, see 66Ge	2E+4	2E+4	9E-6	3E-8	-	-
			St wall (2E+4)	-	-	-	3E-4	3E-3
		W, see 66Ge	-	2E+4	9E-6	3E-8	-	-
33	Arsenic-69[2]	W, all compounds	3E+4	1E+5	5E-5	2E-7	-	-
			St wall (4E+4)	-	-	-	6E-4	6E-3
33	Arsenic-70[2]	W, all compounds	1E+4	5E+4	2E-5	7E-8	2E-4	2E-3
33	Arsenic-71	W, all compounds	4E+3	5E+3	2E-6	6E-9	5E-5	5E-4
33	Arsenic-72	W, all compounds	9E+2	1E+3	6E-7	2E-9	1E-5	1E-4
33	Arsenic-73	W, all compounds	8E+3	2E+3	7E-7	2E-9	1E-4	1E-3
33	Arsenic-74	W, all compounds	1E+3	8E+2	3E-7	1E-9	2E-5	2E-4
33	Arsenic-76	W, all compounds	1E+3	1E+3	6E-7	2E-9	1E-5	1E-4
33	Arsenic-77	W, all compounds	4E+3	5E+3	2E-6	7E-9	-	-
			LLI wall (5E+3)	-	-	-	6E-5	6E-4
33	Arsenic-782	W, all compounds	8E+3	2E+4	9E-6	3E-8	1E-4	1E-3
34	Selenium-70[2]	D, all compounds except those given for W	2E+4	4E+4	2E-5	5E-8	1E-4	1E-3
		W, oxides, hydroxides, carbides, and elemental Se	1E+4	4E+4	2E-5	6E-8	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
34	Selenium-73m[2]	D, see 70Se	6E+4	2E+5	6E-5	2E-7	4E-4	4E-3
		W, see 70Se	3E+4	1E+5	6E-5	2E-7	-	-
34	Selenium-73	D, see 70Se	3E+3	1E+4	5E-6	2E-8	4E-5	4E-4
		W, see 70Se	-	2E+4	7E-6	2E-8	-	-
34	Selenium-75	D, see 70Se	5E+2	7E+2	3E-7	1E-9	7E-6	7E-5
		W, see 70Se	-	6E+2	3E-7	8E-10	-	-
34	Selenium-79	D, see 70Se	6E+2	8E+2	3E-7	1E-9	8E-6	8E-5
		W, see 70Se	-	6E+2	2E-7	8E-10	-	-
34	Selenium-81m[2]	D, see 70Se	4E+4	7E+4	3E-5	9E-8	3E-4	3E-3
		W, see 70Se	2E+4	7E+4	3E-5	1E-7	-	-
34	Selenium-81[2]	D, see 70Se	6E+4	2E+5	9E-5	3E-7	-	-
			St wall (8E+4)	-	-	-	1E-3	1E-2
		W, see 70Se	-	2E+5	1E-4	3E-7	-	-
34	Selenium-83[2]	D, see 70Se	4E+4	1E+5	5E-5	2E-7	4E-4	4E-3
		W, see 70Se	3E+4	1E+5	5E-5	2E-7	-	-
35	Bromine-74m[2]	D, bromides of H, Li, Na, K, Rb, Cs, and Fr	1E+4	4E+4	2E-5	5E-8	-	-
			St wall (2E+4)	-	-	-	3E-4	3E-3
		W, bromides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Mn, Tc, and Re	-	4E+4	2E-5	6E-8	-	-
35	Bromine-74[2]	D, see 74mBr	2E+4	7E+4	3E-5	1E-7	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
		W, see 74mBr	-	8E+4	4E-5	1E-7	-	-
35	Bromine-75[2]	D, see 74mBr	3E+4	5E+4	2E-5	7E-8	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
		W, see 74mBr	-	5E+4	2E-5	7E-8	-	-
35	Bromine-76	D, see 74mBr	4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
		W, see 74mBr	-	4E+3	2E-6	6E-9	-	-
35	Bromine-77	D, see 74mBr	2E+4	2E+4	1E-5	3E-8	2E-4	2E-3
		W, see 74mBr	-	2E+4	8E-6	3E-8	-	-
35	Bromine-80m	D, see 74mBr	2E+4	2E+4	7E-6	2E-8	3E-4	3E-3
		W, see 74mBr	-	1E+4	6E-6	2E-8	-	-
35	Bromine-80[2]	D, see 74mBr	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
		W, see 74mBr	-	2E+5	9E-5	3E-7	-	-
35	Bromine-82	D, see 74mBr	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
		W, see 74mBr	-	4E+3	2E-6	5E-9	-	-
35	Bromine-83	D, see 74mBr	5E+4	6E+4	3E-5	9E-8	-	-
			St wall (7E+4)	-	-	-	9E-4	9E-3
		W, see 74mBr	-	6E+4	3E-5	9E-8	-	-
35	Bromine-84[2]	D, see 74mBr	2E+4	6E+4	2E-5	8E-8	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		W, see 74mBr	-	6E+4	3E-5	9E-8	-	-
36	Krypton-74[2]	Submersion1	-	-	3E-6	1E-8	-	-
36	Krypton-76	Submersion1	-	-	9E-6	4E-8	-	-
36	Krypton-77[2]	Submersion1	-	-	4E-6	2E-8	-	-
36	Krypton-79	Submersion1	-	-	2E-5	7E-8	-	-
36	Krypton-81	Submersion1	-	-	7E-4	3E-6	-	-
36	Krypton-83m[2]	Submersion1	-	-	1E-2	5E-5	-	-
36	Krypton-85m	Submersion1	-	-	2E-5	1E-7	-	-
36	Krypton-85	Submersion1	-	-	1E-4	7E-7	-	-
36	Krypton-87[2]	Submersion1	-	-	5E-6	2E-8	-	-
36	Krypton-88	Submersion1	-	-	2E-6	9E-9	-	-
37	Rubidium-79[2]	D, all compounds	4E+4	1E+5	5E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3
37	Rubidium-81m[2]	D, all compounds	2E+5	3E+5	1E-4	5E-7	-	-
			St wall (3E+5)	-	-	-	4E-3	4E-2
37	Rubidium-81	D, all compounds	4E+4	5E+4	2E-5	7E-8	5E-4	5E-3
37	Rubidium-82m	D, all compounds	1E+4	2E+4	7E-6	2E-8	2E-4	2E-3
37	Rubidium-83	D, all compounds	6E+2	1E+3	4E-7	1E-9	9E-6	9E-5
37	Rubidium-84	D, all compounds	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5
37	Rubidium-86	D, all compounds	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5
37	Rubidium-87	D, all compounds	1E+3	2E+3	6E-7	2E-9	1E-5	1E-4
37	Rubidium-88[2]	D, all compounds	2E+4	6E+4	3E-5	9E-8	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table I Occupational Values Col. 2 Inhalation ALI (μCi)	Table I Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Table II Effluent Concentrations Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
37	Rubidium-89[2]	D, all compounds	4E+4	1E+5	6E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	9E-4	9E-3
38	Strontium-80[2]	D, all soluble compounds except SrTiO	4E+3	1E+4	5E-6	2E-8	6E-5	6E-4
		Y, all insoluble compounds and SrTi0	-	1E+4	5E-6	2E-8	-	-
38	Strontium-81[2]	D, see 80Sr	3E+4	8E+4	3E-5	1E-7	3E-4	3E-3
		Y, see 80Sr	2E+4	8E+4	3E-5	1E-7	-	-
38	Strontium-82	D, see 80Sr	3E+2	4E+2	2E-7	6E-10	-	-
			LLI wall (2E+2)	-	-	-	3E-6	3E-5
		Y, see 80Sr	2E+2	9E+1	4E-8	1E-10	-	-
38	Strontium-83	D, see 80Sr	3E+3	7E+3	3E-6	1E-8	3E-5	3E-4
		Y, see 80Sr	2E+3	4E+3	1E-6	5E-9	-	-
38	Strontium-85m[2]	D, see 80Sr	2E+5	6E+5	3E-4	9E-7	3E-3	3E-2
		Y, see 80Sr	-	8E+5	4E-4	1E-6	-	-
38	Strontium-85	D, see 80Sr	3E+3	3E+3	1E-6	4E-9	4E-5	4E-4
		Y, see 80Sr	-	2E+3	6E-7	2E-9	-	-
38	Strontium-87m	D, see 80Sr	5E+4	1E+5	5E-5	2E-7	6E-4	6E-3
		Y, see 80Sr	4E+4	2E+5	6E-5	2E-7	-	-
38	Strontium-89	D, see 80Sr	6E+2	8E+2	4E-7	1E-9	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
		Y, see 80Sr	5E+2	1E+2	6E-8	2E-10	-	-
38	Strontium-90	D, see 80Sr	3E+1	2E+1	8E-9	-	-	-
			Bone surf (4E+1)	Bone surf (2E+1)	-	3E-11	5E-7	5E-6
		Y, see 80Sr	-	4E+0	2E-9	6E-12	-	-
38	Strontium-91	D, see 80Sr	2E+3	6E+3	2E-6	8E-9	2E-5	2E-4
		Y, see 80Sr	-	4E+3	1E-6	5E-9	-	-
38	Strontium-92	D, see 80Sr	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		Y, see 80Sr	-	7E+3	3E-6	9E-9	-	-
39	Yttrium-86m[2]	W, all compounds except those given for Y	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
		Y, oxides and hydroxides	-	5E+4	2E-5	8E-8	-	-
39	Yttrium-86	W, see 86mY	1E+3	3E+3	1E-6	5E-9	2E-5	2E-4
		Y, see 86mY	-	3E+3	1E-6	5E-9	-	-
39	Yttrium-87	W, see 86mY	2E+3	3E+3	1E-6	5E-9	3E-5	3E-4
		Y, see 86mY	-	3E+3	1E-6	5E-9	-	-
39	Yttrium-88	W, see 86mY	1E+3	3E+2	1E-7	3E-10	1E-5	1E-4
		Y, see 86mY	-	2E+2	1E-7	3E-10	-	-
39	Yttrium-90m	W, see 86mY	8E+3	1E+4	5E-6	2E-8	1E-4	1E-3
		Y, see 86mY	-	1E+4	5E-6	2E-8	-	-
39	Yttrium-90	W, see 86mY	4E+2	7E+2	3E-7	9E-10	-	-
			LLI wall (5E+2)	-	-	-	7E-6	7E-5
		Y, see 86mY	-	6E+2	3E-7	9E-10	-	-
39	Yttrium-91m[2]	W, see 86mY	1E+5	2E+5	1E-4	3E-7	2E-3	2E-2
		Y, see 86mY	-	2E+5	7E-5	2E-7	-	-
39	Yttrium-91	W, see 86mY	5E+2	2E+2	7E-8	2E-10	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
		Y, see 86mY	-	1E+2	5E-8	2E-10	-	-
39	Yttrium-92	W, see 86mY	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		Y, see 86mY	-	8E+3	3E-6	1E-8	-	-
39	Yttrium-93	W, see 86mY	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		Y, see 86mY	-	2E+3	1E-6	3E-9	-	-
39	Yttrium-94[2]	W, see 86mY	2E+4	8E+4	3E-5	1E-7	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		Y, see 86mY	-	8E+4	3E-5	1E-7	-	-
39	Yttrium-95[2]	W, see 86mY	4E+4	2E+5	6E-5	2E-7	-	-
			St wall (5E+4)	-	-	-	7E-4	7E-3
		Y, see 86mY	-	1E+5	6E-5	2E-7	-	-
40	Zirconium-86	D, all compounds except those given for W and Y	1E+3	4E+3	2E-6	6E-9	2E-5	2E-4
		W, oxides, hydroxides, halides, and nitrates	-	3E+3	1E-6	4E-9	-	-
		Y, carbide	-	2E+3	1E-6	3E-9	-	-
40	Zirconium-88	D, see 86Zr	4E+3	2E+2	9E-8	3E-10	5E-5	5E-4
		W, see 86Zr	-	5E+2	2E-7	7E-10	-	-
		Y, see 86Zr	-	3E+2	1E-7	4E-10	-	-
40	Zirconium-89	D, see 86Zr	2E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		W, see 86Zr	-	2E+3	1E-6	3E-9	-	-
		Y, see 86Zr	-	2E+3	1E-6	3E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
40	Zirconium-93	D, see 86Zr	1E+3	6E+0	3E-9	-	-	-
			Bone surf (3E+3)	Bone surf (2E+1)	-	2E-11	4E-5	4E-4
		W, see 86Zr	-	2E+1	1E-8	-	-	-
				Bone surf				
			-	(6E+1)	-	9E-11	-	-
		Y, see 86Zr	-	6E+1	2E-8	-	-	-
				Bone surf				
			-	(7E+1)	-	9E-11	-	-
40	Zirconium-95	D, see 86Zr	1E+3	1E+2	5E-8	-	2E-5	2E-4
				Bone surf				
			-	(3E+2)	-	4E-10	-	-
		W, see 86Zr	-	4E+2	2E-7	5E-10	-	-
		Y, see 86Zr	-	3E+2	1E-7	4E-10	-	-
40	Zirconium-97	D, see 86Zr	6E+2	2E+3	8E-7	3E-9	9E-6	9E-5
		W, see 86Zr	-	1E+3	6E-7	2E-9	-	-
		Y, see 86Zr	-	1E+3	5E-7	2E-9	-	-
41	Niobium-88[2]	W, all compounds except those given for Y	5E+4	2E+5	9E-5	3E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
		Y, oxides and hydroxides	-	2E+5	9E-5	3E-7	-	-
41	Niobium-89[2]	W, see 88Nb (66 min)	1E+4	4E+4	2E-5	6E-8	1E-4	1E-3
		Y, see 88Nb	-	4E+4	2E-5	5E-8	-	-
41	Niobium-89	W, see 88Nb (122 min)	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
		Y, see 88Nb	-	2E+4	6E-6	2E-8	-	-
41	Niobium-90	W, see 88Nb	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
		Y, see 88Nb	-	2E+3	1E-6	3E-9	-	-
41	Niobium-93m	W, see 88Nb	9E+3	2E+3	8E-7	3E-9	-	-
			LLI wall (1E+4)	-	-	-	2E-4	2E-3
		Y, see 88Nb	-	2E+2	7E-8	2E-10	-	-
41	Niobium-94	W, see 88Nb	9E+2	2E+2	8E-8	3E-10	1E-5	1E-4
		Y, see 88Nb	-	2E+1	6E-9	2E-11	-	-
41	Niobium-95m	W, see 88Nb	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		Y, see 88Nb	-	2E+3	9E-7	3E-9	-	-
41	Niobium-95	W, see 88Nb	2E+3	1E+3	5E-7	2E-9	3E-5	3E-4
		Y, see 88Nb	-	1E+3	5E-7	2E-9	-	-
41	Niobium-96	W, see 88Nb	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		Y, see 88Nb	-	2E+3	1E-6	3E-9	-	-
41	Niobium-97[2]	W, see 88Nb	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
		Y, see 88Nb	-	7E+4	3E-5	1E-7	-	-
41	Niobium-98[2]	W, see 88Nb	1E+4	5E+4	2E-5	8E-8	2E-4	2E-3
		Y, see 88Nb	-	5E+4	2E-5	7E-8	-	-
42	Molybdenum-90	D, all compounds except those given for Y	4E+3	7E+3	3E-6	1E-8	3E-5	3E-4
		Y, oxides, hydroxides, and MoS	2E+3	5E+3	2E-6	6E-9	-	-
42	Molybdenum-93m	D, see 90Mo	9E+3	2E+4	7E-6	2E-8	6E-5	6E-4
		Y, see 90Mo	4E+3	1E+4	6E-6	2E-8	-	-
42	Molybdenum-93	D, see 90Mo	4E+3	5E+3	2E-6	8E-9	5E-5	5E-4
		Y, see 90Mo	2E+4	2E+2	8E-8	2E-10	-	-
42	Molybdenum-99	D, see 90Mo	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see 90Mo	1E+3	1E+3	6E-7	2E-9	-	-
42	Molybdenum-101[2]	D, see 90Mo	4E+4	1E+5	6E-5	2E-7	-	-
			St wall (5E+4)	-	-	-	7E-4	7E-3
		Y, see 90Mo	-	1E+5	6E-5	2E-7	-	-
43	Technetium-93m[2]	D, all compounds except those given for W	7E+4	2E+5	6E-5	2E-7	1E-3	1E-2
		W, oxides, hydroxides, halides, and nitrates	-	3E+5	1E-4	4E-7	-	-
43	Technetium-93	D, see 93mTc	3E+4	7E+4	3E-5	1E-7	4E-4	4E-3
		W, see 93mTc	-	1E+5	4E-5	1E-7	-	-
43	Technetium-94m[2]	D, see 93mTc	2E+4	4E+4	2E-5	6E-8	3E-4	3E-3
		W, see 93mTc	-	6E+4	2E-5	8E-8	-	-
43	Technetium-94	D, see 93mTc	9E+3	2E+4	8E-6	3E-8	1E-4	1E-3
		W, see 93mTc	-	2E+4	1E-5	3E-8	-	-
43	Technetium-95m	D, see 93mTc	4E+3	5E+3	2E-6	8E-9	5E-5	5E-4
		W, see 93mTc	-	2E+3	8E-7	3E-9	-	-
43	Technetium-95	D, see 93mTc	1E+4	2E+4	9E-6	3E-8	1E-4	1E-3
		W, see 93mTc	-	2E+4	8E-6	3E-8	-	-
43	Technetium-96m[2]	D, see 93mTc	2E+5	3E+5	1E-4	4E-7	2E-3	2E-2
		W, see 93mTc	-	2E+5	1E-4	3E-7	-	-
43	Technetium-96	D, see 93mTc	2E+3	3E+3	1E-6	5E-9	3E-5	3E-4
		W, see 93mTc	-	2E+3	9E-7	3E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
43	Technetium-97m	D, see 93mTc	5E+3	7E+3	3E-6	-	6E-5	6E-4
			-	St wall (7E+3)	-	1E-8	-	-
		W, see 93mTc	-	1E+3	5E-7	2E-9	-	-
43	Technetium-97	D, see 93mTc	4E+4	5E+4	2E-5	7E-8	5E-4	5E-3
		W, see 93mTc	-	6E+3	2E-6	8E-9	-	-
43	Technetium-98	D, see 93mTc	1E+3	2E+3	7E-7	2E-9	1E-5	1E-4
		W, see 93mTc	-	3E+2	1E-7	4E-10	-	-
43	Technetium-99m	D, see 93mTc	8E+4	2E+5	6E-5	2E-7	1E-3	1E-2
		W, see 93mTc	-	2E+5	1E-4	3E-7	-	-
43	Technetium-99	D, see 93mTc	4E+3	5E+3	2E-6	-	6E-5	6E-4
			-	St wall (6E+3)	-	8E-9	-	-
		W, see 93mTc	-	7E+2	3E-7	9E-10	-	-
43	Technetium-101[2]	D, see 93mTc	9E+4	3E+5	1E-4	5E-7	-	-
			St wall (1E+5)	-	-	-	2E-3	2E-2
		W, see 93mTc	-	4E+5	2E-4	5E-7	-	-
43	Technetium-104[2]	D, see 93mTc	2E+4	7E+4	3E-5	1E-7	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		W, see 93mTc	-	9E+4	4E-5	1E-7	-	-
44	Ruthenium-94[2]	D, all compounds except those given for W and Y	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, halides	-	6E+4	3E-5	9E-8	-	-
		Y, oxides and hydroxides	-	6E+4	2E-5	8E-8	-	-
44	Ruthenium-97	D, see 94Ru	8E+3	2E+4	8E-6	3E-8	1E-4	1E-3
		W, see 94Ru	-	1E+4	5E-6	2E-8	-	-
		Y, see 94Ru	-	1E+4	5E-6	2E-8	-	-
44	Ruthenium-103	D, see 94Ru	2E+3	2E+3	7E-7	2E-9	3E-5	3E-4
		W, see 94Ru	-	1E+3	4E-7	1E-9	-	-
		Y, see 94Ru	-	6E+2	3E-7	9E-10	-	-
44	Ruthenium-105	D, see 94Ru	5E+3	1E+4	6E-6	2E-8	7E-5	7E-4
		W, see 94Ru	-	1E+4	6E-6	2E-8	-	-
		Y, see 94Ru	-	1E+4	5E-6	2E-8	-	-
44	Ruthenium-106	D, see 94Ru	2E+2	9E+1	4E-8	1E-10	-	-
			LLI wall (2E+2)	-	-	-	3E-6	3E-5
		W, see 94Ru	-	5E+1	2E-8	8E-11	-	-
		Y, see 94Ru	-	1E+1	5E-9	2E-11	-	-
45	Rhodium-99m	D, all compounds except those given for W and Y	2E+4	6E+4	2E-5	8E-8	2E-4	2E-3
		W, halides	-	8E+4	3E-5	1E-7	-	-
		Y, oxides and hydroxides	-	7E+4	3E-5	9E-8	-	-
45	Rhodium-99	D, see 99mRh	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
		W, see 99mRh	-	2E+3	9E-7	3E-9	-	-
		Y, see 99mRh	-	2E+3	8E-7	3E-9	-	-
45	Rhodium-100	D, see 99mRh	2E+3	5E+3	2E-6	7E-9	2E-5	2E-4
		W, see 99mRh	-	4E+3	2E-6	6E-9	-	-
		Y, see 99mRh	-	4E+3	2E-6	5E-9	-	-
45	Rhodium-101m	D, see 99mRh	6E+3	1E+4	5E-6	2E-8	8E-5	8E-4
		W, see 99mRh	-	8E+3	4E-6	1E-8	-	-
		Y, see 99mRh	-	8E+3	3E-6	1E-8	-	-
45	Rhodium-101	D, see 99mRh	2E+3	5E+2	2E-7	7E-10	3E-5	3E-4
		W, see 99mRh	-	8E+2	3E-7	1E-9	-	-
		Y, see 99mRh	-	2E+2	6E-8	2E-10	-	-
45	Rhodium-102m	D, see 99mRh	1E+3	5E+2	2E-7	7E-10	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		W, see 99mRh	-	4E+2	2E-7	5E-10	-	-
		Y, see 99mRh	-	1E+2	5E-8	2E-10	-	-
45	Rhodium-102	D, see 99mRh	6E+2	9E+1	4E-8	1E-10	8E-6	8E-5
		W, see 99mRh	-	2E+2	7E-8	2E-10	-	-
		Y, see 99mRh	-	6E+1	2E-8	8E-11	-	-
45	Rhodium-103m[2]	D, see 99mRh	4E+5	1E+6	5E-4	2E-6	6E-3	6E-2
		W, see 99mRh	-	1E+6	5E-4	2E-6	-	-
		Y, see 99mRh	-	1E+6	5E-4	2E-6	-	-
45	Rhodium-105	D, see 99mRh	4E+3	1E+4	5E-6	2E-8	-	-
			LLI wall (4E+3)	-	-	-	5E-5	5E-4
		W, see 99mRh	-	6E+3	3E-6	9E-9	-	-
		Y, see 99mRh	-	6E+3	2E-6	8E-9	-	-
45	Rhodium-106m	D, see 99mRh	8E+3	3E+4	1E-5	4E-8	1E-4	1E-3
		W, see 99mRh	-	4E+4	2E-5	5E-8	-	-
		Y, see 99mRh	-	4E+4	1E-5	5E-8	-	-
45	Rhodium-107[2]	D, see 99mRh	7E+4	2E+5	1E-4	3E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
		W, see 99mRh	-	3E+5	1E-4	4E-7	-	-
		Y, see 99mRh	-	3E+5	1E-4	3E-7	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
46	Palladium-100	D, all compounds except those given for W and Y	1E+3	1E+3	6E-7	2E-9	2E-5	2E-4
		W, nitrates	-	1E+3	5E-7	2E-9	-	-
		Y, oxides and hydroxides	-	1E+3	6E-7	2E-9	-	-
46	Palladium-101	D, see 100Pd	1E+4	3E+4	1E-5	5E-8	2E-4	2E-3
		W, see 100Pd	-	3E+4	1E-5	5E-8	-	-
		Y, see 100Pd	-	3E+4	1E-5	4E-8	-	-
46	Palladium-103	D, see 100Pd	6E+3	6E+3	3E-6	9E-9	-	-
			LLI wall (7E+3)	-	-	-	1E-4	1E-3
		W, see 100Pd	-	4E+3	2E-6	6E-9	-	-
		Y, see 100Pd	-	4E+3	1E-6	5E-9	-	-
46	Palladium-107	D, see 100Pd	3E+4	2E+4	9E-6	-	-	-
			LLI wall (4E+4)	Kidneys (2E+4)	-	3E-8	5E-4	5E-3
		W, see 100Pd	-	7E+3	3E-6	1E-8	-	-
		Y, see 100Pd	-	4E+2	2E-7	6E-10	-	-
46	Palladium-109	D, see 100Pd	2E+3	6E+3	3E-6	9E-9	3E-5	3E-4
		W, see 100Pd	-	5E+3	2E-6	8E-9	-	-
		Y, see 100Pd	-	5E+3	2E-6	6E-9	-	-
47	Silver-102[2]	D, all compounds except those given for W and Y	5E+4	2E+5	8E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	9E-4	9E-3
		W, nitrates and sulfides	-	2E+5	9E-5	3E-7	-	-
		Y, oxides and hydroxides	-	2E+5	8E-5	3E-7	-	-
47	Silver-103[2]	D, see 102Ag	4E+4	1E+5	4E-5	1E-7	5E-4	5E-3
		W, see 102Ag	-	1E+5	5E-5	2E-7	-	-
		Y, see 102Ag	-	1E+5	5E-5	2E-7	-	-
47	Silver-104m[2]	D, see 102Ag	3E+4	9E+4	4E-5	1E-7	4E-4	4E-3
		W, see 102Ag	-	1E+5	5E-5	2E-7	-	-
		Y, see 102Ag	-	1E+5	5E-5	2E-7	-	-
47	Silver-104[2]	D, see 102Ag	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
		W, see 102Ag	-	1E+5	6E-5	2E-7	-	-
		Y, see 102Ag	-	1E+5	6E-5	2E-7	-	-
47	Silver-105	D, see 102Ag	3E+3	1E+3	4E-7	1E-9	4E-5	4E-4
		W, see 102Ag	-	2E+3	7E-7	2E-9	-	-
		Y, see 102Ag	-	2E+3	7E-7	2E-9	-	-
47	Silver-106m	D, see 102Ag	8E+2	7E+2	3E-7	1E-9	1E-5	1E-4
		W, see 102Ag	-	9E+2	4E-7	1E-9	-	-
		Y, see 102Ag	-	9E+2	4E-7	1E-9	-	-
47	Silver-106[2]	D, see 102Ag	6E+4	2E+5	8E-5	3E-7	-	-
			St. wall (6E+4)	-	-	-	9E-4	9E-3
		W, see 102Ag	-	2E+5	9E-5	3E-7	-	-
		Y, see 102Ag	-	2E+5	8E-5	3E-7	-	-
47	Silver-108m	D, see 102Ag	6E+2	2E+2	8E-8	3E-10	9E-6	9E-5
		W, see 102Ag	-	3E+2	1E-7	4E-10	-	-
		Y, see 102Ag	-	2E+1	1E-8	3E-11	-	-
47	Silver-110m	D, see 102Ag	5E+2	1E+2	5E-8	2E-10	6E-6	6E-5
		W, see 102Ag	-	2E+2	8E-8	3E-10	-	-
		Y, see 102Ag	-	9E+1	4E-8	1E-10	-	-
47	Silver-111	D, see 102Ag	9E+2	2E+3	6E-7	-	-	-
			LLI wall (1E+3)	Liver (2E+3)	-	2E-9	2E-5	2E-4
		W, see 102Ag	-	9E+2	4E-7	1E-9	-	-
		Y, see 102Ag	-	9E+2	4E-7	1E-9	-	-
47	Silver-112	D, see 102Ag	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
		W, see 102Ag	-	1E+4	4E-6	1E-8	-	-
		Y, see 102Ag	-	9E+3	4E-6	1E-8	-	-
47	Silver-115[2]	D, see 102Ag	3E+4	9E+4	4E-5	1E-7	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		W, see 102Ag	-	9E+4	4E-5	1E-7	-	-
		Y, see 102Ag	-	8E+4	3E-5	1E-7	-	-
48	Cadmium-104[2]	D, all compounds except those given for W and Y	2E+4	7E+4	3E-5	9E-8	3E-4	3E-3
		W, sulfides, halides, and nitrates	-	1E+5	5E-5	2E-7	-	-
		Y, oxides and hydroxides	-	1E+5	5E-5	2E-7	-	-
48	Cadmium-107	D, see 104Cd	2E+4	5E+4	2E-5	8E-8	3E-4	3E-3
		W, see 104Cd	-	6E+4	2E-5	8E-8	-	-
		Y, see 104Cd	-	5E+4	2E-5	7E-8	-	-
48	Cadmium-109	D, see 104Cd	3E+2	4E+1	1E-8	-	-	-
			Kidneys (4E+2)	Kidneys (5E+1)	-	7E-11	6E-6	6E-5
		W, see 104Cd	-	1E+2	5E-8	-	-	-
			-	Kidneys (1E+2)	-	2E-10	-	-
		Y, see 104Cd	-	1E+2	5E-8	2E-10	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
48	Cadmium-113m	D, see 104Cd	2E+1 Kidneys (4E+1)	2E+0 Kidneys (4E+0)	1E-9 -	- 5E-12	- 5E-7	- 5E-6
		W, see 104Cd	- -	8E+0 Kidneys (1E+1)	4E-9 -	- 2E-11	- -	- -
		Y, see 104Cd	-	1E+1	5E-9	2E-11	-	-
48	Cadmium-113	D, see 104Cd	2E+1 Kidneys (3E+1)	2E+0 Kidneys (3E+0)	9E-10 -	- 5E-12	- 4E-7	- 4E-6
		W, see 104Cd	- -	8E+0 Kidneys (1E+1)	3E-9 -	- 2E-11	- -	- -
		Y, see 104Cd	-	1E+1	6E-9	2E-11	-	-
48	Cadmium-115m	D, see 104Cd	3E+2 -	5E+1 Kidneys (8E+1)	2E-8 -	- 1E-10	4E-6 -	4E-5 -
		W, see 104Cd	-	1E+2	5E-8	2E-10	-	-
		Y, see 104Cd	-	1E+2	6E-8	2E-10	-	-
48	Cadmium-115	D, see 104Cd	9E+2 LLI wall (1E+3)	1E+3 -	6E-7 -	2E-9 -	- 1E-5	- 1E-4
		W, see 104Cd	-	1E+3	5E-7	2E-9	-	-
		Y, see 104Cd	-	1E+3	6E-7	2E-9	-	-
48	Cadmium-117m	D, see 104Cd	5E+3	1E+4	5E-6	2E-8	6E-5	6E-4
		W, see 104Cd	-	2E+4	7E-6	2E-8	-	-
		Y, see 104Cd	-	1E+4	6E-6	2E-8	-	-
48	Cadmium-117	D, see 104Cd	5E+3	1E+4	5E-6	2E-8	6E-5	6E-4
		W, see 104Cd	-	2E+4	7E-6	2E-8	-	-
		Y, see 104Cd	-	1E+4	6E-6	2E-8	-	-
49	Indium-109	D, all compounds except those given for W	2E+4	4E+4	2E-5	6E-8	3E-4	3E-3
		W, oxides, hydroxides, halides, and nitrates	-	6E+4	3E-5	9E-8	-	-
49	Indium-110[2] (69.1 min)	D, see 109In	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see 109In	-	6E+4	2E-5	8E-8	-	-
49	Indium-110 (4.9 h)	D, see 109In	5E+3	2E+4	7E-6	2E-8	7E-5	7E-4
		W, see 109In	-	2E+4	8E-6	3E-8	-	-
49	Indium-111	D, see 109In	4E+3	6E+3	3E-6	9E-9	6E-5	6E-4
		W, see 109In	-	6E+3	3E-6	9E-9	-	-
49	Indium-112[2]	D, see 109In	2E+5	6E+5	3E-4	9E-7	2E-3	2E-2
		W, see 109In	-	7E+5	3E-4	1E-6	-	-
49	Indium-113m[2]	D, see 109In	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
		W, see 109In	-	2E+5	8E-5	3E-7	-	-
49	Indium-114m	D, see 109In	3E+2 LLI wall (4E+2)	6E+1 -	3E-8 -	9E-11 -	- 5E-6	- 5E-5
		W, see 109In	-	1E+2	4E-8	1E-10	-	-
49	Indium-115m	D, see 109In	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see 109In	-	5E+4	2E-5	7E-8	-	-
49	Indium-115	D, see 109In	4E+1	1E+0	6E-10	2E-12	5E-7	5E-6
		W, see 109In	-	5E+0	2E-9	8E-12	-	-
49	Indium-116m[2]	D, see 109In	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
		W, see 109In	-	1E+5	5E-5	2E-7	-	-
49	Indium-117m[2]	D, see 109In	1E+4	3E+4	1E-5	5E-8	2E-4	2E-3
		W, see 109In	-	4E+4	2E-5	6E-8	-	-
49	Indium-1172	D, see 109In	6E+4	2E+5	7E-5	2E-7	8E-4	8E-3
		W, see 109In	-	2E+5	9E-5	3E-7	-	-
49	Indium-119m[2]	D, see 109In	4E+4 St wall (5E+4)	1E+5 -	5E-5 -	2E-7 -	- 7E-4	- 7E-3
		W, see 109In	-	1E+5	6E-5	2E-7	-	-
50	Tin-110	D, all compounds except those given for W	4E+3	1E+4	5E-6	2E-8	5E-5	5E-4
		W, sulfides, oxides, hydroxides, halides, nitrates, and stannic phosphate	-	1E+4	5E-6	2E-8	-	-
50	Tin-111[2]	D, see 110Sn	7E+4	2E+5	9E-5	3E-7	1E-3	1E-2
		W, see 110Sn	-	3E+5	1E-4	4E-7	-	-
50	Tin-113	D, see 110Sn	2E+3 LLI wall (2E+3)	1E+3 -	5E-7 -	2E-9 -	- 3E-5	- 3E-4
		W, see 110Sn	-	5E+2	2E-7	8E-10	-	-
50	Tin-117m	D, see 110Sn	2E+3 LLI wall (2E+3)	1E+3 Bone surf (2E+3)	5E-7 -	- 3E-9	- 3E-5	- 3E-4
		W, see 110Sn	-	1E+3	6E-7	2E-9	-	-
50	Tin-119m	D, see 110Sn	3E+3 LLI wall (4E+3)	2E+3 -	1E-6 -	3E-9 -	- 6E-5	- 6E-4
		W, see 110Sn	-	1E+3	4E-7	1E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
50	Tin-121m	D, see 110Sn	3E+3	9E+2	4E-7	1E-9	-	-
			LLI wall (4E+3)	-	-	-	5E-5	5E-4
		W, see 110Sn	-	5E+2	2E-7	8E-10	-	-
50	Tin-121	D, see 110Sn	6E+3	2E+4	6E-6	2E-8	-	-
			LLI wall (6E+3)	-	-	-	8E-5	8E-4
		W, see 110Sn	-	1E+4	5E-6	2E-8	-	-
50	Tin-123m[2]	D, see 110Sn	5E+4	1E+5	5E-5	2E-7	7E-4	7E-3
		W, see 110Sn	-	1E+5	6E-5	2E-7	-	-
50	Tin-123	D, see 110Sn	5E+2	6E+2	3E-7	9E-10	-	-
			LLI wall (6E+2)	-	-	-	9E-6	9E-5
		W, see 110Sn	-	2E+2	7E-8	2E-10	-	-
50	Tin-125	D, see 110Sn	4E+2	9E+2	4E-7	1E-9	-	-
			LLI wall (5E+2)	-	-	-	6E-6	6E-5
		W, see 110Sn	-	4E+2	1E-7	5E-10	-	-
50	Tin-126	D, see 110Sn	3E+2	6E+1	2E-8	8E-11	4E-6	4E-5
		W, see 110Sn	-	7E+1	3E-8	9E-11	-	-
50	Tin-127	D, see 110Sn	7E+3	2E+4	8E-6	3E-8	9E-5	9E-4
		W, see 110Sn	-	2E+4	8E-6	3E-8	-	-
50	Tin-128[2]	D, see 110Sn	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
		W, see 110Sn	-	4E+4	1E-5	5E-8	-	-
51	Antimony-115[2]	D, all compounds except those given for W	8E+4	2E+5	1E-4	3E-7	1E-3	1E-2
		W, oxides, hydroxides, halides, sulfides, sulfates, and nitrates	-	3E+5	1E-4	4E-7	-	-
51	Antimony-116m[2]	D, see 115Sb	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
		W, see 115Sb	-	1E+5	6E-5	2E-7	-	-
51	Antimony-1162	D, see 115Sb	7E+4	3E+5	1E-4	4E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
		W, see 115Sb	-	3E+5	1E-4	5E-7	-	-
51	Antimony-117	D, see 115Sb	7E+4	2E+5	9E-5	3E-7	9E-4	9E-3
		W, see 115Sb	-	3E+5	1E-4	4E-7	-	-
51	Antimony-118m	D, see 115Sb	6E+3	2E+4	8E-6	3E-8	7E-5	7E-4
		W, see 115Sb	5E+3	2E+4	9E-6	3E-8	-	-
51	Antimony-119	D, see 115Sb	2E+4	5E+4	2E-5	6E-8	2E-4	2E-3
		W, see 115Sb	2E+4	3E+4	1E-5	4E-8	-	-
51	Antimony-1202 (16 min)	D, see 115Sb	1E+5	4E+5	2E-4	6E-7	-	-
			St wall (2E+5)	-	-	-	2E-3	2E-2
		W, see 115Sb	-	5E+5	2E-4	7E-7	-	-
51	Antimony-120	D, see 115Sb	1E+3	2E+3	9E-7	3E-9	1E-5	1E-4
	(5.76 d)	W, see 115Sb	9E+2	1E+3	5E-7	2E-9	-	-
51	Antimony-122	D, see 115Sb	8E+2	2E+3	1E-6	3E-9	-	-
			LLI wall (8E+2)	-	-	-	1E-5	1E-4
		W, see 115Sb	7E+2	1E+3	4E-7	2E-9	-	-
51	Antimony-124m[2]	D, see 115Sb	3E+5	8E+5	4E-4	1E-6	3E-3	3E-2
		W, see 115Sb	2E+5	6E+5	2E-4	8E-7	-	-
51	Antimony-124	D, see 115Sb	6E+2	9E+2	4E-7	1E-9	7E-6	7E-5
		W, see 115Sb	5E+2	2E+2	1E-7	3E-10	-	-
51	Antimony-125	D, see 115Sb	2E+3	2E+3	1E-6	3E-9	3E-5	3E-4
		W, see 115Sb	-	5E+2	2E-7	7E-10	-	-
51	Antimony-126m[2]	D, see 115Sb	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (7E+4)	-	-	-	9E-4	9E-3
		W, see 115Sb	-	2E+5	8E-5	3E-7	-	-
51	Antimony-126	D, see 115Sb	6E+2	1E+3	5E-7	2E-9	7E-6	7E-5
		W, see 115Sb	5E+2	5E+2	2E-7	7E-10	-	-
51	Antimony-127	D, see 115Sb	8E+2	2E+3	9E-7	3E-9	-	-
			LLI wall (8E+2)	-	-	-	1E-5	1E-4
		W, see 115Sb	7E+2	9E+2	4E-7	1E-9	-	-
51	Antimony-128[2]	D, see 115Sb	8E+4	4E+5	2E-4	5E-7	-	-
	(10.4 min)		St wall (1E+5)	-	-	-	1E-3	1E-2
		W, see 115Sb	-	4E+5	2E-4	6E-7	-	-
51	Antimony-128	D, see 115Sb	1E+3	4E+3	2E-6	6E-9	2E-5	2E-4
	(9.01 h)	W, see 115Sb	-	3E+3	1E-6	5E-9	-	-
51	Antimony-129	D, see 115Sb	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		W, see 115Sb	-	9E+3	4E-6	1E-8	-	-
51	Antimony-130[2]	D, see 115Sb	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		W, see 115Sb	-	8E+4	3E-5	1E-7	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
51	Antimony-131[2]	D, see 115Sb	1E+4 Thyroid (2E+4)	2E+4 Thyroid (4E+4)	1E-5 -	6E-8	2E-4	2E-3
		W, see 115Sb	-	2E+4 Thyroid (4E+4)	1E-5 -	6E-8	-	-
52	Tellurium-116	D, all compounds except those given for W	8E+3	2E+4	9E-6	3E-8	1E-4	1E-3
		W, oxides, hydroxides, and nitrates	-	3E+4	1E-5	4E-8	-	-
52	Tellurium-121m	D, see 116Te	5E+2 Bone surf (7E+2)	2E+2 Bone surf (4E+2)	8E-8 -	5E-10	1E-5	1E-4
		W, see 116Te	-	4E+2	2E-7	6E-10	-	-
52	Tellurium-121	D, see 116Te	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
		W, see 116Te	-	3E+3	1E-6	4E-9	-	-
52	Tellurium-123m	D, see 116Te	6E+2 Bone surf (1E+3)	2E+2 Bone surf (5E+2)	9E-8 -	8E-10	1E-5	1E-4
		W, see 116Te	-	5E+2	2E-7	8E-10	-	-
52	Tellurium-123	D, see 116Te	5E+2 Bone surf (1E+3)	2E+2 Bone surf (5E+2)	8E-8 -	7E-10	2E-5	2E-4
		W, see 116Te	-	4E+2 Bone surf (1E+3)	2E-7 -	2E-9	-	-
52	Tellurium-125m	D, see 116Te	1E+3 Bone surf (1E+3)	4E+2 Bone surf (1E+3)	2E-7 -	1E-9	2E-5	2E-4
		W, see 116Te	-	7E+2	3E-7	1E-9	-	-
52	Tellurium-127m	D, see 116Te	6E+2	3E+2 Bone surf (4E+2)	1E-7 -	6E-10	9E-6	9E-5
		W, see 116Te	-	3E+2	1E-7	4E-10	-	-
52	Tellurium-127	D, see 116Te	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
		W, see 116Te	-	2E+4	7E-6	2E-8	-	-
52	Tellurium-129m	D, see 116Te	5E+2	6E+2	3E-7	9E-10	7E-6	7E-5
		W, see 116Te	-	2E+2	1E-7	3E-10	-	-
52	Tellurium-129[2]	D, see 116Te	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
		W, see 116Te	-	7E+4	3E-5	1E-7	-	-
52	Tellurium-131m	D, see 116Te	3E+2 Thyroid (6E+2)	4E+2 Thyroid (1E+3)	2E-7 -	2E-9	8E-6	8E-5
		W, see 116Te	-	4E+2 Thyroid (9E+2)	2E-7 -	1E-9	-	-
52	Tellurium-131[2]	D, see 116Te	3E+3 Thyroid (6E+3)	5E+3 Thyroid (1E+4)	2E-6 -	2E-8	8E-5	8E-4
		W, see 116Te	-	5E+3 Thyroid (1E+4)	2E-6 -	2E-8	-	-
52	Tellurium-132	D, see 116Te	2E+2 Thyroid (7E+2)	2E+2 Thyroid (8E+2)	9E-8 -	1E-9	9E-6	9E-5
		W, see 116Te	-	2E+2 Thyroid (6E+2)	9E-8 -	9E-10	-	-
52	Tellurium-133m[2]	D, see 116Te	3E+3 Thyroid (6E+3)	5E+3 Thyroid (1E+4)	2E-6 -	2E-8	9E-5	9E-4
		W, see 116Te	-	5E+3 Thyroid (1E+4)	2E-6 -	2E-8	-	-
52	Tellurium-133[2]	D, see 116Te	1E+4 Thyroid (3E+4)	2E+4 Thyroid (6E+4)	9E-6 -	8E-8	4E-4	4E-3
		W, see 116Te	-	2E+4 Thyroid (6E+4)	9E-6 -	8E-8	-	-
52	Tellurium-134[2]	D, see 116Te	2E+4 Thyroid (2E+4)	2E+4 Thyroid (5E+4)	1E-5 -	7E-8	3E-4	3E-3
		W, see 116Te	-	2E+4 Thyroid (5E+4)	1E-5 -	7E-8	-	-
53	Iodine-120m[2]	D, all compounds	1E+4 Thyroid (1E+4)	2E+4 -	9E-6 -	3E-8	2E-4	2E-3
53	Iodine-120[2]	D, all compounds	4E+3 Thyroid (8E+3)	9E+3 Thyroid (1E+4)	4E-6 -	2E-8	1E-4	1E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
53	Iodine-121	D, all compounds	1E+4 Thyroid (3E+4)	2E+4 Thyroid (5E+4)	8E-6 -	- 7E-8	- 4E-4	- 4E-3
53	Iodine-123	D, all compounds	3E+3 Thyroid (1E+4)	6E+3 Thyroid (2E+4)	3E-6 -	- 2E-8	- 1E-4	- 1E-3
53	Iodine-124	D, all compounds	5E+1 Thyroid (2E+2)	8E+1 Thyroid (3E+2)	3E-8 -	- 4E-10	- 2E-6	- 2E-5
53	Iodine-125	D, all compounds	4E+1 Thyroid (1E+2)	6E+1 Thyroid (2E+2)	3E-8 -	- 3E-10	- 2E-6	- 2E-5
53	Iodine-126	D, all compounds	2E+1 Thyroid (7E+1)	4E+1 Thyroid (1E+2)	1E-8 -	- 2E-10	- 1E-6	- 1E-5
53	Iodine-128[2]	D, all compounds	4E+4 St wall (6E+4)	1E+5 -	5E-5 -	2E-7 -	- 8E-4	- 8E-3
53	Iodine-129	D, all compounds	5E+0 Thyroid (2E+1)	9E+0 Thyroid (3E+1)	4E-9 -	- 4E-11	- 2E-7	- 2E-6
53	Iodine-130	D, all compounds	4E+2 Thyroid (1E+3)	7E+2 Thyroid (2E+3)	3E-7 -	- 3E-9	- 2E-5	- 2E-4
53	Iodine-131	D, all compounds	3E+1 Thyroid (9E+1)	5E+1 Thyroid (2E+2)	2E-8 -	- 2E-10	- 1E-6	- 1E-5
53	Iodine-132m[2]	D, all compounds	4E+3 Thyroid (1E+4)	8E+3 Thyroid (2E+4)	4E-6 -	- 3E-8	- 1E-4	- 1E-3
53	Iodine-132	D, all compounds	4E+3 Thyroid (9E+3)	8E+3 Thyroid (1E+4)	3E-6 -	- 2E-8	- 1E-4	- 1E-3
53	Iodine-133	D, all compounds	1E+2 Thyroid (5E+2)	3E+2 Thyroid (9E+2)	1E-7 -	- 1E-9	- 7E-6	- 7E-5
53	Iodine-134[2]	D, all compounds	2E+4 Thyroid (3E+4)	5E+4 -	2E-5 -	6E-8 -	- 4E-4	- 4E-3
53	Iodine-135	D, all compounds	8E+2 Thyroid (3E+3)	2E+3 Thyroid (4E+3)	7E-7 -	- 6E-9	- 3E-5	- 3E-4
54	Xenon-120[2]	Submersion1	-	-	1E-5	4E-8	-	-
54	Xenon-121[2]	Submersion1	-	-	2E-6	1E-8	-	-
54	Xenon-122	Submersion1	-	-	7E-5	3E-7	-	-
54	Xenon-123	Submersion1	-	-	6E-6	3E-8	-	-
54	Xenon-125	Submersion1	-	-	2E-5	7E-8	-	-
54	Xenon-127	Submersion1	-	-	1E-5	6E-8	-	-
54	Xenon-129m	Submersion1	-	-	2E-4	9E-7	-	-
54	Xenon-131m	Submersion1	-	-	4E-4	2E-6	-	-
54	Xenon-133m	Submersion1	-	-	1E-4	6E-7	-	-
54	Xenon-133	Submersion1	-	-	1E-4	5E-7	-	-
54	Xenon-135m[2]	Submersion1	-	-	9E-6	4E-8	-	-
54	Xenon-135	Submersion1	-	-	1E-5	7E-8	-	-
54	Xenon-1382	Submersion1	-	-	4E-6	2E-8	-	-
55	Cesium-125[2]	D, all compounds	5E+4 St wall (9E+4)	1E+5 -	6E-5 -	2E-7 -	- 1E-3	- 1E-2
55	Cesium-127	D, all compounds	6E+4	9E+4	4E-5	1E-7	9E-4	9E-3
55	Cesium-129	D, all compounds	2E+4	3E+4	1E-5	5E-8	3E-4	3E-3
55	Cesium-130[2]	D, all compounds	6E+4 St wall (1E+5)	2E+5 -	8E-5 -	3E-7 -	- 1E-3	- 1E-2
55	Cesium-131	D, all compounds	2E+4	3E+4	1E-5	4E-8	3E-4	3E-3
55	Cesium-132	D, all compounds	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
55	Cesium-134m	D, all compounds	1E+5 St wall (1E+5)	1E+5 -	6E-5 -	2E-7 -	- 2E-3	- 2E-2
55	Cesium-134	D, all compounds	7E+1	1E+2	4E-8	2E-10	9E-7	9E-6
55	Cesium-135m[2]	D, all compounds	1E+5	2E+5	8E-5	3E-7	1E-3	1E-2
55	Cesium-135	D, all compounds	7E+2	1E+3	5E-7	2E-9	1E-5	1E-4
55	Cesium-136	D, all compounds	4E+2	7E+2	3E-7	9E-10	6E-6	6E-5
55	Cesium-137	D, all compounds	1E+2	2E+2	6E-8	2E-10	1E-6	1E-5
55	Cesium-138[2]	D, all compounds	2E+4 St wall (3E+4)	6E+4 -	2E-5 -	8E-8 -	- 4E-4	- 4E-3
56	Barium-1262	D, all compounds	6E+3	2E+4	6E-6	2E-8	8E-5	8E-4
56	Barium-128	D, all compounds	5E+2	2E+3	7E-7	2E-9	7E-6	7E-5
56	Barium-131m[2]	D, all compounds	4E+5 St wall (5E+5)	1E+6 -	6E-4 -	2E-6 -	- 7E-3	- 7E-2

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
56	Barium-131	D, all compounds	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
56	Barium-133m	D, all compounds	2E+3	9E+3	4E-6	1E-8	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
56	Barium-133	D, all compounds	2E+3	7E+2	3E-7	9E-10	2E-5	2E-4
56	Barium-135m	D, all compounds	3E+3	1E+4	5E-6	2E-8	4E-5	4E-4
56	Barium-139[2]	D, all compounds	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
56	Barium-140	D, all compounds	5E+2	1E+3	6E-7	2E-9	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
56	Barium-141[2]	D, all compounds	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
56	Barium-142[2]	D, all compounds	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
57	Lanthanum-131[2]	D, all compounds except those given for W	5E+4	1E+5	5E-5	2E-7	6E-4	6E-3
		W, oxides and hydroxides	-	2E+5	7E-5	2E-7	-	-
57	Lanthanum-132	D, see 131La	3E+3	1E+4	4E-6	1E-8	4E-5	4E-4
		W, see 131La	-	1E+4	5E-6	2E-8	-	-
57	Lanthanum-135	D, see 131La	4E+4	1E+5	4E-5	1E-7	5E-4	5E-3
		W, see 131La	-	9E+4	4E-5	1E-7	-	-
57	Lanthanum-137	D, see 131La	1E+4	6E+1 Liver	3E-8	-	2E-4	2E-3
			-	(7E+1)	-	1E-10	-	-
		W, see 131La	-	3E+2 Liver	1E-7	-	-	-
			-	(3E+2)	-	4E-10	-	-
57	Lanthanum-138	D, see 131La	9E+2	4E+0	1E-9	5E-12	1E-5	1E-4
		W, see 131La	-	1E+1	6E-9	2E-11	-	-
57	Lanthanum-140	D, see 131La	6E+2	1E+3	6E-7	2E-9	9E-6	9E-5
		W, see 131La	-	1E+3	5E-7	2E-9	-	-
57	Lanthanum-141	D, see 131La	4E+3	9E+3	4E-6	1E-8	5E-5	5E-4
		W, see 131La	-	1E+4	5E-6	2E-8	-	-
57	Lanthanum-142[2]	D, see 131La	8E+3	2E+4	9E-6	3E-8	1E-4	1E-3
		W, see 131La	-	3E+4	1E-5	5E-8	-	-
57	Lanthanum-143[2]	D, see 131La	4E+4	1E+5	4E-5	1E-7	-	-
			St wall (4E+4)	-	-	-	5E-4	5E-3
		W, see 131La	-	9E+4	4E-5	1E-7	-	-
58	Cerium-134	W, all compounds except those given for Y	5E+2	7E+2	3E-7	1E-9	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
		Y, oxides, hydroxides, and fluorides	-	7E+2	3E-7	9E-10	-	-
58	Cerium-135	W, see 134Ce	2E+3	4E+3	2E-6	5E-9	2E-5	2E-4
		Y, see 134Ce	-	4E+3	1E-6	5E-9	-	-
58	Cerium-137m	W, see 134Ce	2E+3	4E+3	2E-6	6E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		Y, see 134Ce	-	4E+3	2E-6	5E-9	-	-
58	Cerium-137	W, see 134Ce	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
		Y, see 134Ce	-	1E+5	5E-5	2E-7	-	-
58	Cerium-139	W, see 134Ce	5E+3	8E+2	3E-7	1E-9	7E-5	7E-4
		Y, see 134Ce	-	7E+2	3E-7	9E-10	-	-
58	Cerium-141	W, see 134Ce	2E+3	7E+2	3E-7	1E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		Y, see 134Ce	-	6E+2	2E-7	8E-10	-	-
58	Cerium-143	W, see 134Ce	1E+3	2E+3	8E-7	3E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see 134Ce	-	2E+3	7E-7	2E-9	-	-
58	Cerium-144	W, see 134Ce	2E+2	3E+1	1E-8	4E-11	-	-
			LLI wall (3E+2)	-	-	-	3E-6	3E-5
		Y, see 134Ce	-	1E+1	6E-9	2E-11	-	-
59	Praseodymium-136[2]	W, all compounds except those given for Y	5E+4	2E+5	1E-4	3E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
		Y, oxides, hydroxides, carbides, and fluorides	-	2E+5	9E-5	3E-7	-	-
59	Praseodymium-137[2]	W, see 136Pr	4E+4	2E+5	6E-5	2E-7	5E-4	5E-3
		Y, see 136Pr	-	1E+5	6E-5	2E-7	-	-
59	Praseodymium-138m	W, see 136Pr	1E+4	5E+4	2E-5	8E-8	1E-4	1E-3
		Y, see 136Pr	-	4E+4	2E-5	6E-8	-	-
59	Praseodymium-139	W, see 136Pr	4E+4	1E+5	5E-5	2E-7	6E-4	6E-3
		Y, see 136Pr	-	1E+5	5E-5	2E-7	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
59	Praseodymium-142m[2]	W, see 136Pr	8E+4	2E+5	7E-5	2E-7	1E-3	1E-2
		Y, see 136Pr	-	1E+5	6E-5	2E-7	-	-
59	Praseodymium-142	W, see 136Pr	1E+3	2E+3	9E-7	3E-9	1E-5	1E-4
		Y, see 136Pr	-	2E+3	8E-7	3E-9	-	-
59	Praseodymium-143	W, see 136Pr	9E+2	8E+2	3E-7	1E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see 136Pr	-	7E+2	3E-7	9E-10	-	-
59	Praseodymium-144[2]	W, see 136Pr	3E+4	1E+5	5E-5	2E-7	-	-
			St wall (4E+4)	-	-	-	6E-4	6E-3
		Y, see 136Pr	-	1E+5	5E-5	2E-7	-	-
59	Praseodymium-145	W, see 136Pr	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		Y, see 136Pr	-	8E+3	3E-6	1E-8	-	-
59	Praseodymium-147[2]	W, see 136Pr	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (8E+4)	-	-	-	1E-3	1E-2
		Y, see 136Pr	-	2E+5	8E-5	3E-7	-	-
60	Neodymium-136[2]	W, all compounds except those given for Y	1E+4	6E+4	2E-5	8E-8	2E-4	2E-3
		Y, oxides, hydroxides, carbides, and fluorides	-	5E+4	2E-5	8E-8	-	-
60	Neodymium-138	W, see 136Nd	2E+3	6E+3	3E-6	9E-9	3E-5	3E-4
		Y, see 136Nd	-	5E+3	2E-6	7E-9	-	-
60	Neodymium-139m	W, see 136Nd	5E+3	2E+4	7E-6	2E-8	7E-5	7E-4
		Y, see 136Nd	-	1E+4	6E-6	2E-8	-	-
60	Neodymium-139[2]	W, see 136Nd	9E+4	3E+5	1E-4	5E-7	1E-3	1E-2
		Y, see 136Nd	-	3E+5	1E-4	4E-7	-	-
60	Neodymium-141	W, see 136Nd	2E+5	7E+5	3E-4	1E-6	2E-3	2E-2
		Y, see 136Nd	-	6E+5	3E-4	9E-7	-	-
60	Neodymium-147	W, see 136Nd	1E+3	9E+2	4E-7	1E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see 136Nd	-	8E+2	4E-7	1E-9	-	-
60	Neodymium-149[2]	W, see 136Nd	1E+4	3E+4	1E-5	4E-8	1E-4	1E-3
		Y, see 136Nd	-	2E+4	1E-5	3E-8	-	-
60	Neodymium-151[2]	W, see 136Nd	7E+4	2E+5	8E-5	3E-7	9E-4	9E-3
		Y, see 136Nd	-	2E+5	8E-5	3E-7	-	-
61	Promethium-141[2]	W, all compounds except those given for Y	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3
		Y, oxides, hydroxides, carbides, and fluorides	-	2E+5	7E-5	2E-7	-	-
61	Promethium-143	W, see 141Pm	5E+3	6E+2	2E-7	8E-10	7E-5	7E-4
		Y, see 141Pm	-	7E+2	3E-7	1E-9	-	-
61	Promethium-144	W, see 141Pm	1E+3	1E+2	5E-8	2E-10	2E-5	2E-4
		Y, see 141Pm	-	1E+2	5E-8	2E-10	-	-
61	Promethium-145	W, see 141Pm	1E+4	2E+2	7E-8	-	1E-4	1E-3
			-	Bone surf (2E+2)	-	3E-10	-	-
		Y, see 141Pm	-	2E+2	8E-8	3E-10	-	-
61	Promethium-146	W, see 141Pm	2E+3	5E+1	2E-8	7E-11	2E-5	2E-4
		Y, see 141Pm	-	4E+1	2E-8	6E-11	-	-
61	Promethium-147	W, see 141Pm	4E+3	1E+2	5E-8	-	-	-
			LLI wall (5E+3)	Bone surf (2E+2)	-	3E-10	7E-5	7E-4
		Y, see 141Pm	-	1E+2	6E-8	2E-10	-	-
61	Promethium-148m	W, see 141Pm	7E+2	3E+2	1E-7	4E-10	1E-5	1E-4
		Y, see 141Pm	-	3E+2	1E-7	5E-10	-	-
61	Promethium-148	W, see 141Pm	4E+2	5E+2	2E-7	8E-10	-	-
			LLI wall (5E+2)	-	-	-	7E-6	7E-5
		Y, see 141Pm	-	5E+2	2E-7	7E-10	-	-
61	Promethium-149	W, see 141Pm	1E+3	2E+3	8E-7	3E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see 141Pm	-	2E+3	8E-7	2E-9	-	-
61	Promethium-150	W, see 141Pm	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
		Y, see 141Pm	-	2E+4	7E-6	2E-8	-	-
61	Promethium-151	W, see 141Pm	2E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		Y, see 141Pm	-	3E+3	1E-6	4E-9	-	-
62	Samarium-141m[2]	W, all compounds	3E+4	1E+5	4E-5	1E-7	4E-4	4E-3
62	Samarium-1412	W, all compounds	5E+4	2E+5	8E-5	2E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
62	Samarium-142[2]	W, all compounds	8E+3	3E+4	1E-5	4E-8	1E-4	1E-3
62	Samarium-145	W, all compounds	6E+3	5E+2	2E-7	7E-10	8E-5	8E-4
62	Samarium-146	W, all compounds	1E+1 Bone surf (3E+1)	4E2 Bone surf (6E-2)	1E-11 -	- 9E-14	- 3E-7	- 3E-6
62	Samarium-147	W, all compounds	2E+1 Bone surf (3E+1)	4E2 Bone surf (7E-2)	2E-11 -	- 1E-13	- 4E-7	- 4E-6
62	Samarium-151	W, all compounds	1E+4 LLI wall (1E+4)	1E+2 Bone surf (2E+2)	4E-8 -	- 2E-10	- 2E-4	- 2E-3
62	Samarium-153	W, all compounds	2E+3 LLI wall (2E+3)	3E+3 -	1E-6 -	4E-9 -	- 3E-5	- 3E-4
62	Samarium-155[2]	W, all compounds	6E+4 St wall (8E+4)	2E+5 -	9E-5 -	3E-7 -	- 1E-3	- 1E-2
62	Samarium-156	W, all compounds	5E+3	9E+3	4E-6	1E-8	7E-5	7E-4
63	Europium-145	W, all compounds	2E+3	2E+3	8E-7	3E-9	2E-5	2E-4
63	Europium-146	W, all compounds	1E+3	1E+3	5E-7	2E-9	1E-5	1E-4
63	Europium-147	W, all compounds	3E+3	2E+3	7E-7	2E-9	4E-5	4E-4
63	Europium-148	W, all compounds	1E+3	4E+2	1E-7	5E-10	1E-5	1E-4
63	Europium-149	W, all compounds	1E+4	3E+3	1E-6	4E-9	2E-4	2E-3
63	Europium-150 (12.62 h)	W, all compounds	3E+3	8E+3	4E-6	1E-8	4E-5	4E-4
63	Europium-150 (34.2 y)	W, all compounds	8E+2	2E+1	8E-9	3E-11	1E-5	1E-4
63	Europium-152m	W, all compounds	3E+3	6E+3	3E-6	9E-9	4E-5	4E-4
63	Europium-152	W, all compounds	8E+2	2E+1	1E-8	3E-11	1E-5	1E-4
63	Europium-154	W, all compounds	5E+2	2E+1	8E-9	3E-11	7E-6	7E-5
63	Europium-155	W, all compounds	4E+3 -	9E+1 Bone surf (1E+2)	4E-8 -	- 2E-10	5E-5 -	5E-4 -
63	Europium-156	W, all compounds	6E+2	5E+2	2E-7	6E-10	8E-6	8E-5
63	Europium-157	W, all compounds	2E+3	5E+3	2E-6	7E-9	3E-5	3E-4
63	Europium-158[2]	W, all compounds	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
64	Gadolinium-145[2]	D, all compounds except those given for W	5E+4 St wall (5E+4)	2E+5 -	6E-5 -	2E-7 -	- 6E-4	- 6E-3
		W, oxides, hydroxides, and fluorides	-	2E+5	7E-5	2E-7	-	-
64	Gadolinium-146	D, see 145Gd	1E+3	1E+2	5E-8	2E-10	2E-5	2E-4
		W, see 145Gd	-	3E+2	1E-7	4E-10	-	-
64	Gadolinium-147	D, see 145Gd	2E+3	4E+3	2E-6	6E-9	3E-5	3E-4
		W, see 145Gd	-	4E+3	1E-6	5E-9	-	-
64	Gadolinium-148	D, see 145Gd	1E+1 Bone surf (2E+1)	8E+3 Bone surf (2E+2)	3E-12 -	- 2E-14	- 3E-7	- 3E-6
		W, see 145Gd	-	3E-2 Bone surf (6E-2)	1E-11 -	- 8E-14	- -	- -
64	Gadolinium-149	D, see 145Gd	3E+3	2E+3	9E-7	3E-9	4E-5	4E-4
		W, see 145Gd	-	2E+3	1E-6	3E-9	-	-
64	Gadolinium-151	D, see 145Gd	6E+3 -	4E+2 Bone surf (6E+2)	2E-7 -	- 9E-10	9E-5 -	9E-4 -
		W, see 145Gd	-	1E+3	5E-7	2E-9	-	-
64	Gadolinium-152	D, see 145Gd	2E+1 Bone surf (3E+1)	1E-2 Bone surf (2E-2)	4E-12 -	- 3E-14	- 4E-7	- 4E-6
		W, see 145Gd	-	4E-2 Bone surf	2E-11	-	-	-
64	Gadolinium-153	D, see 145Gd	5E+3 -	1E+2 Bone surf (2E+2)	6E-8 -	- 3E-10	6E-5 -	6E-4 -
		W, see 145Gd	-	6E+2	2E-7	8E-10	-	-
64	Gadolinium-159	D, see 145Gd	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
		W, see 145Gd	-	6E+3	2E-6	8E-9	-	-
65	Terbium-147[2]	W, all compounds	9E+3	3E+4	1E-5	5E-8	1E-4	1E-3
65	Terbium-149	W, all compounds	5E+3	7E+2	3E-7	1E-9	7E-5	7E-4
65	Terbium-150	W, all compounds	5E+3	2E+4	9E-6	3E-8	7E-5	7E-4
65	Terbium-151	W, all compounds	4E+3	9E+3	4E-6	1E-8	5E-5	5E-4
65	Terbium-153	W, all compounds	5E+3	7E+3	3E-6	1E-8	7E-5	7E-4
65	Terbium-154	W, all compounds	2E+3	4E+3	2E-6	6E-9	2E-5	2E-4
65	Terbium-155	W, all compounds	6E+3	8E+3	3E-6	1E-8	8E-5	8E-4

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Col. 2 Inhalation ALI (µCi)	Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
			-	(8E-2)	-	1E-13	-	-
65	Terbium-156m (5.0 h)	W, all compounds	2E+4	3E+4	1E-5	4E-8	2E-4	2E-3
65	Terbium-156m (24.4 h)	W, all compounds	7E+3	8E+3	3E-6	1E-8	1E-4	1E-3
65	Terbium-156	W, all compounds	1E+3	1E+3	6E-7	2E-9	1E-5	1E-4
65	Terbium-157	W, all compounds	5E+4	3E+2	1E-7	-	-	-
			LLI wall (5E+4)	Bone surf (6E+2)	-	8E-10	7E-4	7E-3
65	Terbium-158	W, all compounds	1E+3	2E+1	8E-9	3E-11	2E-5	2E-4
65	Terbium-160	W, all compounds	8E+2	2E+2	9E-8	3E-10	1E-5	1E-4
65	Terbium-161	W, all compounds	2E+3	2E+3	7E-7	2E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
66	Dysprosium-155	W, all compounds	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
66	Dysprosium-157	W, all compounds	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
66	Dysprosium-159	W, all compounds	1E+4	2E+3	1E-6	3E-9	2E-4	2E-3
66	Dysprosium-165	W, all compounds	1E+4	5E+4	2E-5	6E-8	2E-4	2E-3
66	Dysprosium-166	W, all compounds	6E+2	7E+2	3E-7	1E-9	-	-
			LLI wall (8E+2)	-	-	-	1E-5	1E-4
67	Holmium-155[2]	W, all compounds	4E+4	2E+5	6E-5	2E-7	6E-4	6E-3
67	Holmium-157[2]	W, all compounds	3E+5	1E+6	6E-4	2E-6	4E-3	4E-2
67	Holmium-159[2]	W, all compounds	2E+5	1E+6	4E-4	1E-6	3E-3	3E-2
67	Holmium-161	W, all compounds	1E+5	4E+5	2E-4	6E-7	1E-3	1E-2
67	Holmium-162m[2]	W, all compounds	5E+4	3E+5	1E-4	4E-7	7E-4	7E-3
67	Holmium-162[2]	W, all compounds	5E+5	2E+6	1E-3	3E-6	-	-
			St wall (8E+5)	-	-	-	1E-2	1E-1
67	Holmium-164m[2]	W, all compounds	1E+5	3E+5	1E-4	4E-7	1E-3	1E-2
67	Holmium-1642	W, all compounds	2E+5	6E+5	3E-4	9E-7	-	-
			St wall (2E+5)	-	-	-	3E-3	3E-2
67	Holmium-166m	W, all compounds	6E+2	7E+0	3E-9	9E-12	9E-6	9E-5
67	Holmium-166	W, all compounds	9E+2	2E+3	7E-7	2E-9	-	-
			LLI wall (9E+2)	-	-	-	1E-5	1E-4
67	Holmium-167	W, all compounds	2E+4	6E+4	2E-5	8E-8	2E-4	2E-3
68	Erbium-161	W, all compounds	2E+4	6E+4	3E-5	9E-8	2E-4	2E-3
68	Erbium-165	W, all compounds	6E+4	2E+5	8E-5	3E-7	9E-4	9E-3
68	Erbium-169	W, all compounds	3E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (4E+3)	-	-	-	5E-5	5E-4
68	Erbium-171	W, all compounds	4E+3	1E+4	4E-6	1E-8	5E-5	5E-4
68	Erbium-172	W, all compounds	1E+3	1E+3	6E-7	2E-9	-	-
			LLI wall (E+3)	-	-	-	2E-5	2E-4
69	Thulium-162[2]	W, all compounds	7E+4	3E+5	1E-4	4E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
69	Thulium-166	W, all compounds	4E+3	1E+4	6E-6	2E-8	6E-5	6E-4
69	Thulium-167	W, all compounds	2E+3	2E+3	8E-7	3E-9	-	-
			LLI wall (2E+3)-	-	-	3E-5	3E-4	
69	Thulium-170	W, all compounds	8E+2	2E+2	9E-8	3E-10	-	-
			LLI wall (1E+3)	-	-	-	1E-5	1E-4
69	Thulium-171	W, all compounds	1E+4	3E+2	1E-7	-	-	-
			LLI wall (1E+4)	Bone surf (6E+2)	-	8E-10	2E-4	2E-3
69	Thulium-172	W, all compounds	7E+2	1E+3	5E-7	2E-9	-	-
			LLI wall (8E+2)	-	-	-	1E-5	1E-4
69	Thulium-173	W, all compounds	4E+3	1E+4	5E-6	2E-8	6E-5	6E-4
69	Thulium-175[2]	W, all compounds	7E+4	3E+5	1E-4	4E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
70	Ytterbium-162[2]	W, all compounds except those given for Y Y, oxides, hydroxides, and fluorides	7E+4	3E+5	1E-4	4E-7	1E-3	1E-2
			-	3E+5	1E-4	4E-7	-	-
70	Ytterbium-166	W, see 162Yb	1E+3	2E+3	8E-7	3E-9	2E-5	2E-4
		Y, see 162Yb	-	2E+3	8E-7	3E-9	-	-
70	Ytterbium-167[2]	W, see 162Yb	3E+5	8E+5	3E-4	1E-6	4E-3	4E-2
		Y, see 162Yb	-	7E+5	3E-4	1E-6	-	-
70	Ytterbium-169	W, see 162Yb	2E+3	8E+2	4E-7	1E-9	2E-5	2E-4
		Y, see 162Yb	-	7E+2	3E-7	1E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
70	Ytterbium-175	W, see 162Yb	3E+3	4E+3	1E-6	5E-9	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
		Y, see 162Yb	-	3E+3	1E-6	5E-9	-	-
70	Ytterbium-177[2]	W, see 162Yb	2E+4	5E+4	2E-5	7E-8	2E-4	2E-3
		Y, see 162Yb	-	5E+4	2E-5	6E-8	-	-
70	Ytterbium-178[2]	W, see 162Yb	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		Y, see 162Yb	-	4E+4	2E-5	5E-8	-	-
71	Lutetium-169	W, all compounds except those given for Y	3E+3	4E+3	2E-6	6E-9	3E-5	3E-4
		Y, oxides, hydroxides, and fluorides	-	4E+3	2E-6	6E-9	-	-
71	Lutetium-170	W, see 169Lu	1E+3	2E+3	9E-7	3E-9	2E-5	2E-4
		Y, see 169Lu	-	2E+3	8E-7	3E-9	-	-
71	Lutetium-171	W, see 169Lu	2E+3	2E+3	8E-7	3E-9	3E-5	3E-4
		Y, see 169Lu	-	2E+3	8E-7	3E-9	-	-
71	Lutetium-172	W, see 169Lu	1E+3	1E+3	5E-7	2E-9	1E-5	1E-4
		Y, see 169Lu	-	1E+3	5E-7	2E-9	-	-
71	Lutetium-173	W, see 169Lu	5E+3	3E+2	1E-7	-	7E-5	7E-4
				Bone surf				
			-	(5E+2)	-	6E-10	-	-
		Y, see 169Lu	-	3E+2	1E-7	4E-10	-	-
71	Lutetium-174m	W, see 169Lu	2E+3	2E+2	1E-7	-	-	-
			LLI wall	Bone surf				
			(3E+3)	(3E+2)	-	5E-10	4E-5	4E-4
		Y, see 169Lu	-	2E+2	9E-8	3E-10	-	-
71	Lutetium-174	W, see 169Lu	5E+3	1E+2	5E-8	-	7E-5	7E-4
				Bone surf				
			-	(2E+2)	-	3E-10	-	-
		Y, see 169Lu	-	2E+2	6E-8	2E-10	-	-
71	Lutetium-176m	W, see 169Lu	8E+3	3E+4	1E-5	3E-8	1E-4	1E-3
		Y, see 169Lu	-	2E+4	9E-6	3E-8	-	-
71	Lutetium-176	W, see 169Lu	7E+2	5E+0	2E-9	-	1E-5	1E-4
				Bone surf				
			-	(1E+1)	-	2E-11	-	-
		Y, see 169Lu	-	8E+0	3E-9	1E-11	-	-
71	Lutetium-177m	W, see 169Lu	7E+2	1E+2	5E-8	-	1E-5	1E-4
				Bone surf				
			-	(1E+2)	-	2E-10	-	-
		Y, see 169Lu	-	8E+1	3E-8	1E-10	-	-
71	Lutetium-177	W, see 169Lu	2E+3	2E+3	9E-7	3E-9	-	-
			LLI wall					
			(3E+3)	-	-	-	4E-5	4E-4
		Y, see 169Lu	-	2E+3	9E-7	3E-9	-	-
71	Lutetium-178m2	W, see 169Lu	5E+4	2E+5	8E-5	3E-7	-	-
			St. wall					
			(6E+4)	-	-	-	8E-4	8E-3
		Y, see 169Lu	-	2E+5	7E-5	2E-7	-	-
71	Lutetium-178[2]	W, see 169Lu	4E+4	1E+5	5E-5	2E-7	-	-
			St wall					
			(4E+4)	-	-	-	6E-4	6E-3
		Y, see 169Lu	-	1E+5	5E-5	2E-7	-	-
71	Lutetium-179	W, see 169Lu	6E+3	2E+4	8E-6	3E-8	9E-5	9E-4
		Y, see 169Lu	-	2E+4	6E-6	3E-8	-	-
72	Hafnium-170	D, all compounds except those given for W	3E+3	6E+3	2E-6	8E-9	4E-5	4E-4
		W, oxides, hydroxides, carbides, and nitrates	-	5E+3	2E-6	6E-9	-	-
72	Hafnium-172	D, see 170Hf	1E+3	9E+0	4E-9	-	2E-5	2E-4
				Bone surf				
			-	(2E+1)	-	3E-11	-	-
		W, see 170Hf	-	4E+1	2E-8	-	-	-
				Bone surf				
			-	(6E+1)	-	8E-11	-	-
72	Hafnium-173	D, see 170Hf	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
		W, see 170Hf	-	1E+4	5E-6	2E-8	-	-
72	Hafnium-175	D, see 170Hf	3E+3	9E+2	4E-7	-	4E-5	4E-4
				Bone surf				
			-	(1E+3)	-	1E-9	-	-
		W, see 170Hf	-	1E+3	5E-7	2E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
72	Hafnium-177m[2]	D, see 170Hf	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
		W, see 170Hf	-	9E+4	4E-5	1E-7	-	-
72	Hafnium-178m	D, see 170Hf	3E+2	1E+0	5E-10	-	3E-6	3E-5
			-	Bone surf (2E+0)	-	3E-12	-	-
		W, see 170Hf	-	5E+0	2E-9	-	-	-
			-	Bone surf (9E+0)	-	1E-11	-	-
72	Hafnium-179m	D, see 170Hf	1E+3	3E+2	1E-7	-	1E-5	1E-4
			-	Bone surf (6E+2)	-	8E-10	-	-
		W, see 170Hf	-	6E+2	3E-7	8E-10	-	-
72	Hafnium-180m	D, see 170Hf	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
		W, see 170Hf	-	3E+4	1E-5	4E-8	-	-
72	Hafnium-181	D, see 170Hf	1E+3	2E+2	7E-8	-	2E-5	2E-4
			-	Bone surf (4E+2)	-	6E-10	-	-
		W, see 170Hf	-	4E+2	2E-7	6E-10	-	-
72	Hafnium-182m[2]	D, see 170Hf	4E+4	9E+4	4E-5	1E-7	5E-4	5E-3
		W, see 170Hf	-	1E+5	6E-5	2E-7	-	-
72	Hafnium-182	D, see 170Hf	2E+2	8E-1	3E-10	-	-	-
			Bone surf (4E+2)	Bone surf (2E+0)	-	2E-12	5E-6	5E-5
		W, see 170Hf	-	3E+0	1E-9	-	-	-
			-	Bone surf (7E+0)	-	1E-11	-	-
72	Hafnium-183[2]	D, see 170Hf	2E+4	5E+4	2E-5	6E-8	3E-4	3E-3
		W, see 170Hf	-	6E+4	2E-5	8E-8	-	-
72	Hafnium-184	D, see 170Hf	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
		W, see 170Hf	-	6E+3	3E-6	9E-9	-	-
73	Tantalum-172[2]	W, all compounds except those given for Y	4E+4	1E+5	5E-5	2E-7	5E-4	5E-3
		Y, elemental Ta, oxides, hydroxides, halides, carbides, nitrates, and nitrides	-	1E+5	4E-5	1E-7	-	-
73	Tantalum-173	W, see 172Ta	7E+3	2E+4	8E-6	3E-8	9E-5	9E-4
		Y, see 172Ta	-	2E+4	7E-6	2E-8	-	-
73	Tantalum-174[2]	W, see 172Ta	3E+4	1E+5	4E-5	1E-7	4E-4	4E-3
		Y, see 172Ta	-	9E+4	4E-5	1E-7	-	-
73	Tantalum-175	W, see 172Ta	6E+3	2E+4	7E-6	2E-8	8E-5	8E-4
		Y, see 172Ta	-	1E+4	6E-6	2E-8	-	-
73	Tantalum-176	W, see 172Ta	4E+3	1E+4	5E-6	2E-8	5E-5	5E-4
		Y, see 172Ta	-	1E+4	5E-6	2E-8	-	-
73	Tantalum-177	W, see 172Ta	1E+4	2E+4	8E-6	3E-8	2E-4	2E-3
		Y, see 172Ta	-	2E+4	7E-6	2E-8	-	-
73	Tantalum-178	W, see 172Ta	2E+4	9E+4	4E-5	1E-7	2E-4	2E-3
		Y, see 172Ta	-	7E+4	3E-5	1E-7	-	-
73	Tantalum-179	W, see 172Ta	2E+4	5E+3	2E-6	8E-9	3E-4	3E-3
		Y, see 172Ta	-	9E+2	4E-7	1E-9	-	-
73	Tantalum-180m	W, see 172Ta	2E+4	7E+4	3E-5	9E-8	3E-4	3E-3
		Y, see 172Ta	-	6E+4	2E-5	8E-8	-	-
73	Tantalum-180	W, see 172Ta	1E+3	4E+2	2E-7	6E-10	2E-5	2E-4
		Y, see 172Ta	-	2E+1	1E-8	3E-11	-	-
73	Tantalum-182m[2]	W, see 172Ta	2E+5	5E+5	2E-4	8E-7	-	-
			St wall (2E+5)	-	-	-	3E-3	3E-2
		Y, see 172Ta	-	4E+5	2E-4	6E-7	-	-
73	Tantalum-182	W, see 172Ta	8E+2	3E+2	1E-7	5E-10	1E-5	1E-4
		Y, see 172Ta	-	1E+2	6E-8	2E-10	-	-
73	Tantalum-183	W, see 172Ta	9E+2	1E+3	5E-7	2E-9	-	-
			LLI wall (1E+3)	-	-	-	2E-5	2E-4
		Y, see 172Ta	-	1E+3	4E-7	1E-9	-	-
73	Tantalum-184	W, see 172Ta	2E+3	5E+3	2E-6	8E-9	3E-5	3E-4
		Y, see 172Ta	-	5E+3	2E-6	7E-9	-	-
73	Tantalum-185[2]	W, see 172Ta	3E+4	7E+4	3E-5	1E-7	4E-4	4E-3
		Y, see 172Ta	-	6E+4	3E-5	9E-8	-	-
73	Tantalum-186[2]	W, see 172Ta	5E+4	2E+5	1E-4	3E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
		Y, see 172Ta	-	2E+5	9E-5	3E-7	-	-
74	Tungsten-176	D, all compounds	1E+4	5E+4	2E-5	7E-8	1E-4	1E-3
74	Tungsten-177	D, all compounds	2E+4	9E+4	4E-5	1E-7	3E-4	3E-3
74	Tungsten-178	D, all compounds	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
74	Tungsten-179[2]	D, all compounds	5E+5	2E+6	7E-4	2E-6	7E-3	7E-2
74	Tungsten-181	D, all compounds	2E+4	3E+4	1E-5	5E-8	2E-4	2E-3
74	Tungsten-185	D, all compounds	2E+3	7E+3	3E-6	9E-9	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
74	Tungsten-187	D, all compounds	2E+3	9E+3	4E-6	1E-8	3E-5	3E-4
74	Tungsten-188	D, all compounds	4E+2	1E+3	5E-7	2E-9	-	-
			LLI wall (5E+2)	-	-	-	7E-6	7E-5
75	Rhenium-177[2]	D, all compounds except those given for W	9E+4	3E+5	1E-4	4E-7	-	-
			St wall (1E+5)	-	-	-	2E-3	2E-2
		W, oxides, hydroxides, and nitrates	-	4E+5	1E-4	5E-7	-	-
75	Rhenium-178[2]	D, see 177Re	7E+4	3E+5	1E-4	4E-7	-	-
			St wall (1E+5)	-	-	-	1E-3	1E-2
		W, see 177Re	-	3E+5	1E-4	4E-7	-	-
75	Rhenium-181	D, see 177Re	5E+3	9E+3	4E-6	1E-8	7E-5	7E-4
		W, see 177Re	-	9E+3	4E-6	1E-8	-	-
75	Rhenium-182 (12.7 h)	D, see 177Re	7E+3	1E+4	5E-6	2E-8	9E-5	9E-4
		W, see 177Re	-	2E+4	6E-6	2E-8	-	-
75	Rhenium-182 (64.0 h)	D, see 177Re	1E+3	2E+3	1E-6	3E-9	2E-5	2E-4
		W, see 177Re	-	2E+3	9E-7	3E-9	-	-
75	Rhenium-184m	D, see 177Re	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
		W, see 177Re	-	4E+2	2E-7	6E-10	-	-
75	Rhenium-184	D, see 177Re	2E+3	4E+3	1E-6	5E-9	3E-5	3E-4
		W, see 177Re	-	1E+3	6E-7	2E-9	-	-
75	Rhenium-186m	D, see 177Re	1E+3	2E+3	7E-7	-	-	-
			St wall (2E+3)	St wall (2E+3)	-	3E-9	2E-5	2E-4
		W, see 177Re	-	2E+2	6E-8	2E-10	-	-
75	Rhenium-186	D, see 177Re	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
		W, see 177Re	-	2E+3	7E-7	2E-9	-	-
75	Rhenium-187	D, see 177Re	6E+5	8E+5	4E-4	-	8E-3	8E-2
			-	St wall (9E+5)	-	1E-6	-	-
		W, see 177Re	-	1E+5	4E-5	1E-7	-	-
75	Rhenium-188m[2]	D, see 177Re	8E+4	1E+5	6E-5	2E-7	1E-3	1E-2
		W, see 177Re	-	1E+5	6E-5	2E-7	-	-
75	Rhenium-188	D, see 177Re	2E+3	3E+3	1E-6	4E-9	2E-5	2E-4
		W, see 177Re	-	3E+3	1E-6	4E-9	-	-
75	Rhenium-189	D, see 177Re	3E+3	5E+3	2E-6	7E-9	4E-5	4E-4
		W, see 177Re	-	4E+3	2E-6	6E-9	-	-
76	Osmium-180[2]	D, all compounds except those given for W and Y	1E+5	4E+5	2E-4	5E-7	1E-3	1E-2
		W, halides and nitrates	-	5E+5	2E-4	7E-7	-	-
		Y, oxides and hydroxides	-	5E+5	2E-4	6E-7	-	-
76	Osmium-181[2]	D, see 180Os	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see 180Os	-	5E+4	2E-5	6E-8	-	-
		Y, see 180Os	-	4E+4	2E-5	6E-8	-	-
76	Osmium-182	D, see 180Os	2E+3	6E+3	2E-6	8E-9	3E-5	3E-4
		W, see 180Os	-	4E+3	2E-6	6E-9	-	-
		Y, see 180Os	-	4E+3	2E-6	6E-9	-	-
76	Osmium-185	D, see 180Os	2E+3	5E+2	2E-7	7E-10	3E-5	3E-4
		W, see 180Os	-	8E+2	3E-7	1E-9	-	-
		Y, see 180Os	-	8E+2	3E-7	1E-9	-	-
76	Osmium-189m	D, see 180Os	8E+4	2E+5	1E-4	3E-7	1E-3	1E-2
		W, see 180Os	-	2E+5	9E-5	3E-7	-	-
		Y, see 180Os	-	2E+5	7E-5	2E-7	-	-
76	Osmium-191m	D, see 180Os	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see 180Os	-	2E+4	8E-6	3E-8	-	-
		Y, see 180Os	-	2E+4	7E-6	2E-8	-	-
76	Osmium-191	D, see 180Os	2E+3	2E+3	9E-7	3E-9	-	-
			LLI wall (3E+3)	-	-	-	3E-5	3E-4
		W, see 180Os	-	2E+3	7E-7	2E-9	-	-
		Y, see 180Os	-	1E+3	6E-7	2E-9	-	-
76	Osmium-193	D, see 180Os	2E+3	5E+3	2E-6	6E-9	-	-
			LLI wall (2E+3)	-	-	-	2E-5	2E-4
		W, see 180Os	-	3E+3	1E-6	4E-9	-	-
		Y, see 180Os	-	3E+3	1E-6	4E-9	-	-
76	Osmium-194	D, see 180Os	4E+2	4E+1	2E-8	6E-11	-	-
			LLI wall (6E+2)	-	-	-	8E-6	8E-5
		W, see 180Os	-	6E+1	2E-8	8E-11	-	-
		Y, see 180Os	-	8E+0	3E-9	1E-11	-	-
77	Iridium-182[2]	D, all compounds except those given for W and Y	4E+4	1E+5	6E-5	2E-7	-	-
			St wall (4E+4)	-	-	-	6E-4	6E-3
		W, halides, nitrates, and metallic iridium	-	2E+5	6E-5	2E-7	-	-
		Y, oxides and hydroxides	-	1E+5	5E-5	2E-7	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
77	Iridium-184	D, see 182Ir	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3
		W, see 182Ir	-	3E+4	1E-5	5E-8	-	-
		Y, see 182Ir	-	3E+4	1E-5	4E-8	-	-
77	Iridium-185	D, see 182Ir	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
		W, see 182Ir	-	1E+4	5E-6	2E-8	-	-
		Y, see 182Ir	-	1E+4	4E-6	1E-8	-	-
77	Iridium-186	D, see 182Ir	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
		W, see 182Ir	-	6E+3	3E-6	9E-9	-	-
		Y, see 182Ir	-	6E+3	2E-6	8E-9	-	-
77	Iridium-187	D, see 182Ir	1E+4	3E+4	1E-5	5E-8	1E-4	1E-3
		W, see 182Ir	-	3E+4	1E-5	4E-8	-	-
		Y, see 182Ir	-	3E+4	1E-5	4E-8	-	-
77	Iridium-188	D, see 182Ir	2E+3	5E+3	2E-6	6E-9	3E-5	3E-4
		W, see 182Ir	-	4E+3	1E-6	5E-9	-	-
		Y, see 182Ir	-	3E+3	1E-6	5E-9	-	-
77	Iridium-189	D, see 182Ir	5E+3	5E+3	2E-6	7E-9	-	-
			LLI wall (5E+3)	-	-	-	7E-5	7E-4
		W, see 182Ir	-	4E+3	2E-6	5E-9	-	-
		Y, see 182Ir	-	4E+3	1E-6	5E-9	-	-
77	Iridium-190m[2]	D, see 182Ir	2E+5	2E+5	8E-5	3E-7	2E-3	2E-2
		W, see 182Ir	-	2E+5	9E-5	3E-7	-	-
		Y, see 182Ir	-	2E+5	8E-5	3E-7	-	-
77	Iridium-190	D, see 182Ir	1E+3	9E+2	4E-7	1E-9	1E-5	1E-4
		W, see 182Ir	-	1E+3	4E-7	1E-9	-	-
		Y, see 182Ir	-	9E+2	4E-7	1E-9	-	-
77	Iridium-192m	D, see 182Ir	3E+3	9E+1	4E-8	1E-10	4E-5	4E-4
		W, see 182Ir	-	2E+2	9E-8	3E-10	-	-
		Y, see 182Ir	-	2E+1	6E-9	2E-11	-	-
77	Iridium-192	D, see 182Ir	9E+2	3E+2	1E-7	4E-10	1E-5	1E-4
		W, see 182Ir	-	4E+2	2E-7	6E-10	-	-
		Y, see 182Ir	-	2E+2	9E-8	3E-10	-	-
77	Iridium-194m	D, see 182Ir	6E+2	9E+1	4E-8	1E-10	9E-6	9E-5
		W, see 182Ir	-	2E+2	7E-8	2E-10	-	-
		Y, see 182Ir	-	1E+2	4E-8	1E-10	-	-
77	Iridium-194	D, see 182Ir	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
		W, see 182Ir	-	2E+3	9E-7	3E-9	-	-
		Y, see 182Ir	-	2E+3	8E-7	3E-9	-	-
77	Iridium-195m	D, see 182Ir	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3
		W, see 182Ir	-	3E+4	1E-5	4E-8	-	-
		Y, see 182Ir	-	2E+4	9E-6	3E-8	-	-
77	Iridium-195	D, see 182Ir	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see 182Ir	-	5E+4	2E-5	7E-8	-	-
		Y, see 182Ir	-	4E+4	2E-5	6E-8	-	-
78	Platinum-186	D, all compounds	1E+4	4E+4	2E-5	5E-8	2E-4	2E-3
78	Platinum-188	D, all compounds	2E+3	2E+3	7E-7	2E-9	2E-5	2E-4
78	Platinum-189	D, all compounds	1E+4	3E+4	1E-5	4E-8	1E-4	1E-3
78	Platinum-191	D, all compounds	4E+3	8E+3	4E-6	1E-8	5E-5	5E-4
78	Platinum-193m	D, all compounds	3E+3	6E+3	3E-6	8E-9	-	-
			LLI wall (3E+4)	-	-	-	4E-5	4E-4
78	Platinum-193	D, all compounds	4E+4	2E+4	1E-5	3E-8	-	-
			LLI wall (5E+4)	-	-	-	6E-4	6E-3
78	Platinum-195m	D, all compounds	2E+3	4E+3	2E-6	6E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
78	Platinum-197m[2]	D, all compounds	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
78	Platinum-197	D, all compounds	3E+3	1E+4	4E-6	1E-8	4E-5	4E-4
78	Platinum-199[2]	D, all compounds	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
78	Platinum-200	D, all compounds	1E+3	3E+3	1E-6	5E-9	2E-5	2E-4
79	Gold-193	D, all compounds except those given for W and Y	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
		W, halides and nitrates	-	2E+4	9E-6	3E-8	-	-
		Y, oxides and hydroxides	-	2E+4	8E-6	3E-8	-	-
79	Gold-194	D, see 193Au	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
		W, see 193Au	-	5E+3	2E-6	8E-9	-	-
		Y, see 193Au	-	5E+3	2E-6	7E-9	-	-
79	Gold-195	D, see 193Au	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
		W, see 193Au	-	1E+3	6E-7	2E-9	-	-
		Y, see 193Au	-	4E+2	2E-7	6E-10	-	-
79	Gold-198m	D, see 193Au	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
		W, see 193Au	-	1E+3	5E-7	2E-9	-	-
		Y, see 193Au	-	1E+3	5E-7	2E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
79	Gold-198	D, see 193Au	1E+3	4E+3	2E-6	5E-9	2E-5	2E-4
		W, see 193Au	-	2E+3	8E-7	3E-9	-	-
		Y, see 193Au	-	2E+3	7E-7	2E-9	-	-
79	Gold-199	D, see 193Au	3E+3	9E+3	4E-6	1E-8	-	-
			LLI wall (3E+3)	-	-	-	4E-5	4E-4
		W, see 193Au	-	4E+3	2E-6	6E-9	-	-
		Y, see 193Au	-	4E+3	2E-6	5E-9	-	-
79	Gold-200m	D, see 193Au	1E+3	4E+3	1E-6	5E-9	2E-5	2E-4
		W, see 193Au	-	3E+3	1E-6	4E-9	-	-
		Y, see 193Au	-	2E+4	1E-6	3E-9	-	-
79	Gold-200[2]	D, see 193Au	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
		W, see 193Au	-	8E+4	3E-5	1E-7	-	-
		Y, see 193Au	-	7E+4	3E-5	1E-7	-	-
79	Gold-201[2]	D, see 193Au	7E+4	2E+5	9E-5	3E-7	-	-
			St wall (9E+4)	-	-	-	1E-3	1E-2
		W, see 193Au	-	2E+5	1E-4	3E-7	-	-
		Y, see 193Au	-	2E+5	9E-5	3E-7	-	-
80	Mercury-193m	Vapor	-	8E+3	4E-6	1E-8	-	-
		Organic D	4E+3	1E+4	5E-6	2E-8	6E-5	6E-4
		D, sulfates	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
		W, oxides, hydroxides, halides, nitrates, and sulfides	-	8E+3	3E-6	1E-8	-	-
80	Mercury-193	Vapor	-	3E+4	1E-5	4E-8	-	-
		Organic D	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		D, see 193mHg	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see 193mHg	-	4E+4	2E-5	6E-8	-	-
80	Mercury-194	Vapor	-	3E+1	1E-8	4E-11	-	-
		Organic D	2E+1	3E+1	1E-8	4E-11	2E-7	2E-6
		D, see 193mHg	8E+2	4E+1	2E-8	6E-11	1E-5	1E-4
		W, see 193mHg	-	1E+2	5E-8	2E-10	-	-
80	Mercury-195m	Vapor	-	4E+3	2E-6	6E-9	-	-
		Organic D	3E+3	6E+3	3E-6	8E-9	4E-5	4E-4
		D, see 193mHg	2E+3	5E+3	2E-6	7E-9	3E-5	3E-4
		W, see 193mHg	-	4E+3	2E-6	5E-9	-	-
80	Mercury-195	Vapor	-	3E+4	1E-5	4E-8	-	-
		Organic D	2E+4	5E+4	2E-5	6E-8	2E-4	2E-3
		D, see 193mHg	1E+4	4E+4	1E-5	5E-8	2E-4	2E-3
		W, see 193mHg	-	3E+4	1E-5	5E-8	-	-
80	Mercury-197m	Vapor	-	5E+3	2E-6	7E-9	-	-
		Organic D	4E+3	9E+3	4E-6	1E-8	5E-5	5E-4
		D, see 193mHg	3E+3	7E+3	3E-6	1E-8	4E-5	4E-4
		W, see 193mHg	-	5E+3	2E-6	7E-9	-	-
80	Mercury-197	Vapor	-	8E+3	4E-6	1E-8	-	-
		Organic D	7E+3	1E+4	6E-6	2E-8	9E-5	9E-4
		D, see 193mHg	6E+3	1E+4	5E-6	2E-8	8E-5	8E-4
		W, see 193mHg	-	9E+3	4E-6	1E-8	-	-
80	Mercury-199m[2]	Vapor	-	8E+4	3E-5	1E-7	-	-
		Organic D	6E+4	2E+5	7E-5	2E-7	-	-
			St wall (1E+5)	-	-	-	1E-3	1E-2
		D, see 193mHg	6E+4	1E+5	6E-5	2E-7	8E-4	8E-3
		W, see 193mHg	-	2E+5	7E-5	2E-7	-	-
80	Mercury-203	Vapor	-	8E+2	4E-7	1E-9	-	-
		Organic D	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5
		D, see 193mHg	2E+3	1E+3	5E-7	2E-9	3E-5	3E-4
		W, see 193mHg	-	1E+3	5E-7	2E-9	-	-
81	Thallium-194m[2]	D, all compounds	5E+4	2E+5	6E-5	2E-7	-	-
			St wall (7E+4)	-	-	-	1E-3	1E-2
81	Thallium-194[2]	D, all compounds	3E+5	6E+5	2E-4	8E-7	-	-
			St wall (3E+5)	-	-	-	4E-3	4E-2
81	Thallium-195[2]	D, all compounds	6E+4	1E+5	5E-5	2E-7	9E-4	9E-3
81	Thallium-197	D, all compounds	7E+4	1E+5	5E-5	2E-7	1E-3	1E-2
81	Thallium-198m[2]	D, all compounds	3E+4	5E+4	2E-5	8E-8	4E-4	4E-3
81	Thallium-198	D, all compounds	2E+4	3E+4	1E-5	5E-8	3E-4	3E-3
81	Thallium-199	D, all compounds	6E+4	8E+4	4E-5	1E-7	9E-4	9E-3
81	Thallium-200	D, all compounds	8E+3	1E+4	5E-6	2E-8	1E-4	1E-3
81	Thallium-201	D, all compounds	2E+4	2E+4	9E-6	3E-8	2E-4	2E-3
81	Thallium-202	D, all compounds	4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
81	Thallium-204	D, all compounds	2E+3	2E+3	9E-7	3E-9	2E-5	2E-4
82	Lead-195m[2]	D, all compounds	6E+4	2E+5	8E-5	3E-7	8E-4	8E-3
82	Lead-198	D, all compounds	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
82	Lead-1992	D, all compounds	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
82	Lead-200	D, all compounds	3E+3	6E+3	3E-6	9E-9	4E-5	4E-4
82	Lead-201	D, all compounds	7E+3	2E+4	8E-6	3E-8	1E-4	1E-3
82	Lead-202m	D, all compounds	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
82	Lead-202	D, all compounds	1E+2	5E+1	2E-8	7E-11	2E-6	2E-5
82	Lead-203	D, all compounds	5E+3	9E+3	4E-6	1E-8	7E-5	7E-4
82	Lead-205	D, all compounds	4E+3	1E+3	6E-7	2E-9	5E-5	5E-4
82	Lead-209	D, all compounds	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
82	Lead-210	D, all compounds	6E1 Bone surf (1E+0)	2E1 Bone surf (4E-1)	1E-10 -	- 6E-13	- 1E-8	- 1E-7
82	Lead-211[2]	D, all compounds	1E+4	6E+2	3E-7	9E-10	2E-4	2E-3
82	Lead-212	D, all compounds	8E+1 Bone surf (1E+2)	3E+1 -	1E-8 -	5E-11 -	- 2E-6	- 2E-5
82	Lead-214[2]	D, all compounds	9E+3	8E+2	3E-7	1E-9	1E-4	1E-3
83	Bismuth-200[2]	D, nitrates	3E+4	8E+4	4E-5	1E-7	4E-4	4E-3
		W, all other compounds	-	1E+5	4E-5	1E-7	-	-
83	Bismuth-201[2]	D, see 200Bi	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
		W, see 200Bi	-	4E+4	2E-5	5E-8	-	-
83	Bismuth-202[2]	D, see 200Bi	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
		W, see 200Bi	-	8E+4	3E-5	1E-7	-	-
83	Bismuth-203	D, see 200Bi	2E+3	7E+3	3E-6	9E-9	3E-5	3E-4
		W, see 200Bi	-	6E+3	3E-6	9E-9	-	-
83	Bismuth-205	D, see 200Bi	1E+3	3E+3	1E-6	3E-9	2E-5	2E-4
		W, see 200Bi	-	1E+3	5E-7	2E-9	-	-
83	Bismuth-206	D, see 200Bi	6E+2	1E+3	6E-7	2E-9	9E-6	9E-5
		W, see 200Bi	-	9E+2	4E-7	1E-9	-	-
83	Bismuth-207	D, see 200Bi	1E+3	2E+3	7E-7	2E-9	1E-5	1E-4
		W, see 200Bi	-	4E+2	1E-7	5E-10	-	-
83	Bismuth-210m	D, see 200Bi	4E+1 Kidneys (6E+1)	5E+0 Kidneys (6E+0)	2E-9 -	- 9E-12	- 8E-7	- 8E-6
		W, see 200Bi	-	7E-1	3E-10	9E-13	-	-
83	Bismuth-210	D, see 200Bi	8E+2 - -	2E+2 Kidneys (4E+2)	1E-7 -	- 5E-10	1E-5 -	1E-4 -
		W, see 200Bi	-	3E+1	1E-8	4E-11	-	-
83	Bismuth-212[2]	D, see 200Bi	5E+3	2E+2	1E-7	3E-10	7E-5	7E-4
		W, see 200Bi	-	3E+2	1E-7	4E-10	-	-
83	Bismuth-213[2]	D, see 200Bi	7E+3	3E+2	1E-7	4E-10	1E-4	1E-3
		W, see 200Bi	-	4E+2	1E-7	5E-10	-	-
83	Bismuth-214[2]	D, see 200Bi	2E+4 St wall (2E+4)	8E+2 -	3E-7 -	1E-9 -	- 3E-4	- 3E-3
		W, see 200Bi	-	9E-2	4E-7	1E-9	-	-
84	Polonium-203[2]	D, all compounds except those given for W	3E+4	6E+4	3E-5	9E-8	3E-4	3E-3
		W, oxides, hydroxides, and nitrates	-	9E+4	4E-5	1E-7	-	-
84	Polonium-205[2]	D, see 203Po	2E+4	4E+4	2E-5	5E-8	3E-4	3E-3
		W, see 203Po	-	7E+4	3E-5	1E-7	-	-
84	Polonium-207	D, see 203Po	8E+3	3E+4	1E-5	3E-8	1E-4	1E-3
		W, see 203Po	-	3E+4	1E-5	4E-8	-	-
84	Polonium-210	D, see 203Po	3E+0	6E-1	3E-10	9E-13	4E-8	4E-7
		W, see 203Po	-	6E-1	3E-10	9E-13	-	-
85	Astatine-207[2]	D, halides	6E+3	3E+3	1E-6	4E-9	8E-5	8E-4
		W	-	2E+3	9E-7	3E-9	-	-
85	Astatine-211	D, halides	1E+2	8E+1	3E-8	1E-10	2E-6	2E-5
		W	-	5E+1	2E-8	8E-11	-	-
86	Radon-220	With daughters removed	-	2E+4	7E-6	2E-8	-	-
		With daughters present	-	2E+1 (or 12 WLM)	9E-9 (or 1.0 WL)	3E-11	-	-
86	Radon-222	With daughters removed	-	1E+4	4E-6	1E-8	-	-
		With daughters present	-	1E+2 (or 4 WLM)	3E-8 (or 0.33 WL)	1E-10	-	-
87	Francium-222[2]	D, all compounds	2E+3	5E+2	2E-7	6E-10	3E-5	3E-4
87	Francium-223[2]	D, all compounds	6E+2	8E+2	3E-7	1E-9	8E-6	8E-5
88	Radium-223	W, all compounds	5E+0 Bone surf (9E+0)	7E-1 -	3E-10 -	9E-13 -	- 1E-7	- 1E-6
88	Radium-224	W, all compounds	8E+0 Bone surf (2E+1)	2E+0 -	7E-10 -	2E-12 -	- 2E-7	- 2E-6
88	Radium-225	W, all compounds	8E+0 Bone surf (2E+1)	7E-1 -	3E-10 -	9E-13 -	- 2E-7	- 2E-6

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
88	Radium-226	W, all compounds	2E+0	6E-1	3E-10	9E-13	-	-
			Bone surf (5E+0)	-	-	-	6E-8	6E-7
88	Radium-227[2]	W, all compounds	2E+4	1E+4	6E-6	-	-	-
			Bone surf (2E+4)	Bone surf (2E+4)	-	3E-8	3E-4	3E-3
88	Radium-228	W, all compounds	2E+0	1E+0	5E-10	2E-12	-	-
			Bone surf (4E+0)	-	-	-	6E-8	6E-7
89	Actinium-224	D, all compounds except those given for W and Y	2E+3	3E+1	1E-8	-	-	-
			LLI wall (2E+3)	Bone surf (4E+1)	-	5E-11	3E-5	3E-4
		W, halides and nitrates	-	5E+1	2E-8	7E-11	-	-
		Y, oxides and hydroxides	-	5E+1	2E-8	6E-11	-	-
89	Actinium-225	D, see 224Ac	5E+1	3E-1	1E-10	-	-	-
			LLI wall (5E+1)	Bone surf (5E-1)	-	7E-13	7E-7	7E-6
		W, see 224Ac	-	6E-1	3E-10	9E-13	-	-
		Y, see 224Ac	-	6E-1	3E-10	9E-13	-	-
89	Actinium-226	D, see 224Ac	1E+2	3E+0	1E-9	-	-	-
			LLI wall (1E+2)	Bone surf (4E+0)	-	5E-12	2E-6	2E-5
		W, see 224Ac	-	5E+0	2E-9	7E-12	-	-
		Y, see 224Ac	-	5E+0	2E-9	6E-12	-	-
89	Actinium-227	D, see 224Ac	2E-1	4E-4	2E-13	-	-	-
			Bone surf (4E-1)	Bone surf (8E-4)	-	1E-15	5E-9	5E-8
		W, see 224Ac	-	2E-3	7E-13	-	-	-
			Bone surf -	(3E-3)	-	4E-15	-	-
		Y, see 224Ac	-	4E-3	2E-12	6E-15	-	-
89	Actinium-228	D, see 224Ac	2E+3	9E+0	4E-9	-	3E-5	3E-4
				Bone surf				
			-	(2E+1)	-	2E-11	-	-
		W, see 224Ac	-	4E+1	2E-8	-	-	-
				Bone surf				
			-	(6E+1)	-	8E-11	-	-
		Y, see 224Ac	-	4E+1	2E-8	6E-11	-	-
90	Thorium-2262	W, all compounds except those given for Y	5E+3	2E+2	6E-8	2E-10	-	-
			St wall (5E+3)	-	-	-	7E-5	7E-4
		Y, oxides and hydroxides	-	1E+2	6E-8	2E-10	-	-
90	Thorium-227	W, see 226Th	1E+2	3E-1	1E-10	5E-13	2E-6	2E-5
		Y, see 226Th	-	3E-1	1E-10	5E-13	-	-
90	Thorium-228	W, see 226Th	6E+0	1E-2	4E-12	-	-	-
			Bone surf (1E+1)	Bone surf (2E-2)	-	3E-14	2E-7	2E-6
		Y, see 226Th	-	2E-2	7E-12	2E-14	-	-
90	Thorium-229	W, see 226Th	6E-1	9E-4	4E-13	-	-	-
			Bone surf (1E+0)	Bone surf (2E-3)	-	3E-15	2E-8	2E-7
		Y, see 226Th	-	2E-3	1E-12	-	-	-
				Bone surf				
			-	(3E-3)	-	4E-15	-	-
90	Thorium-230	W, see 226Th	4E+0	6E-3	3E-12	-	-	-
			Bone surf (9E+0)	Bone surf (2E-2)	-	2E-14	1E-7	1E-6
		Y, see 226Th	-	2E-2	6E-12	-	-	-
				Bone surf				
			-	(2E-2)	-	3E-14	-	-
90	Thorium-231	W, see 226Th	4E+3	6E+3	3E-6	9E-9	5E-5	5E-4
		Y, see 226Th	-	6E+3	3E-6	9E-9	-	-
90	Thorium-232	W, see 226Th	7E-1	1E-3	5E-13	-	-	-
			Bone surf (2E+0)	Bone surf (3E-3)	-	4E-15	3E-8	3E-7
		Y, see 226Th	-	3E-3	1E-12	-	-	-
				Bone surf				
			-	(4E-3)	-	6E-15	-	-
90	Thorium-234	W, see 226Th	3E+2	2E+2	8E-8	3E-10	-	-
			LLI wall (4E+2)	-	-	-	5E-6	5E-5
		Y, see 226Th	-	2E+2	6E-8	2E-10	-	-
91	Protactinium-227[2]	W, all compounds except those given for Y	4E+3	1E+2	5E-8	2E-10	5E-5	5E-4
		Y, oxides and hydroxides	-	1E+2	4E-8	1E-10	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
91	Protactinium-228	W, see 227Pa	1E+3	1E+1	5E-9	-	2E-5	2E-4
			-	Bone surf (2E+1)	-	3E-11	-	-
		Y, see 227Pa	-	1E+1	5E-9	2E-11	-	-
91	Protactinium-230	W, see 227Pa	6E+2	5E+0	2E-9	7E-12	-	-
			Bone surf (9E+2)	-	-	-	1E-5	1E-4
		Y, see 227Pa	-	4E+0	1E-9	5E-12	-	-
91	Protactinium-231	W, see 227Pa	2E-1	2E-3	6E-13	-	-	-
			Bone surf (5E-1)	Bone surf (4E-3)	-	6E-15	6E-9	6E-8
		Y, see 227Pa	-	4E-3	2E-12	-	-	-
			-	Bone surf (6E-3)	-	8E-15	-	-
91	Protactinium-232	W, see 227Pa	1E+3	2E+1	9E-9	-	2E-5	2E-4
			-	Bone surf (6E+1)	-	8E-11	-	-
		Y, see 227Pa	-	6E+1	2E-8	-	-	-
			-	Bone surf (7E+1)	-	1E-10	-	-
91	Protactinium-233	W, see 227Pa	1E+3	7E+2	3E-7	1E-9	-	-
			LLI wall (2E+3)	-	-	-	2E-5	2E-4
		Y, see 227Pa	-	6E+2	2E-7	8E-10	-	-
91	Protactinium-234	W, see 227Pa	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
		Y, see 227Pa	-	7E+3	3E-6	9E-9	-	-
92	Uranium-230	D, UF, UOF, UO(NO)	4E+0	4E-1	2E-10	-	-	-
			Bone surf (6E+0)	Bone surf (6E-1)	-	8E-13	8E-8	8E-7
		W, UO, UF, UCl	-	4E-1	1E-10	5E-13	-	-
		Y, UO, UO	-	3E-1	1E-10	4E-13	-	-
92	Uranium-231	D, see 230U	5E+3	8E+3	3E-6	1E-8	-	-
			LLI wall (4E+3)	-	-	-	6E-5	6E-4
		W, see 230U	-	6E+3	2E-6	8E-9	-	-
		Y, see 230U	-	5E+3	2E-6	6E-9	-	-
92	Uranium-232	D, see 230U	2E+0	2E-1	9E-11	-	-	-
			Bone surf (4E+0)	Bone surf (4E-1)	-	6E-13	6E-8	6E-7
		W, see 230U	-	4E-1	2E-10	5E-13	-	-
		Y, see 230U	-	8E-3	3E-12	1E-14	-	-
92	Uranium-233	D, see 230U	1E+1	1E+0	5E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see 230U	-	7E-1	3E-10	1E-12	-	-
		Y, see 230U	-	4E-2	2E-11	5E-14	-	-
92	Uranium-234[3]	D, see 230U	1E+1	1E+0	5E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see 230U	-	7E-1	3E-10	1E-12	-	-
		Y, see 230U	-	4E-2	2E-11	5E-14	-	-
92	Uranium-235[3]	D, see 230U	1E+1	1E+0	6E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see 230U	-	8E-1	3E-10	1E-12	-	-
		Y, see 230U	-	4E-2	2E-11	6E-14	-	-
92	Uranium-236	D, see 230U	1E+1	1E+0	5E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see 230U	-	8E-1	3E-10	1E-12	-	-
		Y, see 230U	-	4E-2	2E-11	6E-14	-	-
92	Uranium-237	D, see 230U	2E+3	3E+3	1E-6	4E-9	-	-
			LLI wall (2E+3)	-	-	-	3E-5	3E-4
		W, see 230U	-	2E+3	7E-7	2E-9	-	-
		Y, see 230U	-	2E+3	6E-7	2E-9	-	-
92	Uranium-238[3]	D, see 230U	1E+1	1E+0	6E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see 230U	-	8E-1	3E-10	1E-12	-	-
		Y, see 230U	-	4E-2	2E-11	6E-14	-	-
92	Uranium-239[2]	D, see 230U	7E+4	2E+5	8E-5	3E-7	9E-4	9E-3
		W, see 230U	-	2E+5	7E-5	2E-7	-	-
		Y, see 230U	-	2E+5	6E-5	2E-7	-	-
92	Uranium-240	D, see 230U	1E+3	4E+3	2E-6	5E-9	2E-5	2E-4
		W, see 230U	-	3E+3	1E-6	4E-9	-	-
		Y, see 230U	-	2E+3	1E-6	3E-9	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
92	Uranium-natural[3]	D, see 230U	1E+1	1E+0	5E-10	-	-	-
			Bone surf (2E+1)	Bone surf (2E+0)	-	3E-12	3E-7	3E-6
		W, see 230U	-	8E-1	3E-10	9E-13	-	-
		Y, see 230U	-	5E-2	2E-11	9E-14	-	-
93	Neptunium-232[2]	W, all compounds	1E+5	2E+3	7E-7	-	2E-3	2E-2
			-	Bone surf (5E+2)	-	6E-9	-	-
93	Neptunium-233[2]	W, all compounds	8E+5	3E+6	1E-3	4E-6	1E-2	1E-1
93	Neptunium-234	W, all compounds	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
93	Neptunium-235	W, all compounds	2E+4	8E+2	3E-7	-	-	-
			LLI wall (2E+4)	Bone surf (1E+3)	-	2E-9	3E-4	3E-3
93	Neptunium-236 (1.15E+5 y)	W, all compounds	3E+0	2E-2	9E-12	-	-	-
			Bone surf (6E+0)	Bone surf (5E-2)	-	8E-14	9E-8	9E-7
93	Neptunium-236 (22.5 h)	W, all compounds	3E+3	3E+1	1E-8	-	-	-
			Bone surf (4E+3)	Bone surf (7E+1)	-	1E-10	5E-5	5E-4
93	Neptunium-237	W, all compounds	5E-1	4E-3	2E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	1E-14	2E-8	2E-7
93	Neptunium-238	W, all compounds	1E+3	6E+1	3E-8	-	2E-5	2E-4
			-	Bone surf (2E+2)	-	2E-10	-	-
93	Neptunium-239	W, all compounds	2E+3	2E+3	9E-7	3E-9	-	-
			LLI wall (2E+3)	-	-	-	2E-5	2E-4
93	Neptunium-240[2]	W, all compounds	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
94	Plutonium-234	W, all compounds except PuO	8E+3	2E+2	9E-8	3E-10	1E-4	1E-3
		Y, PuO	-	2E+2	8E-8	3E-10	-	-
94	Plutonium-235[2]	W, see 234Pu	9E+5	3E+6	1E-3	4E-6	1E-2	1E-1
		Y, see 234Pu	-	3E+6	1E-3	3E-6	-	-
94	Plutonium-236	W, see 234Pu	2E+0	2E-2	8E-12	-	-	-
			Bone surf (4E+0)	Bone surf (4E-2)	-	5E-14	6E-8	6E-7
		Y, see 234Pu	-	4E-2	2E-11	6E-14	-	-
94	Plutonium-237	W, see 234Pu	1E+4	3E+3	1E-6	5E-9	2E-4	2E-3
		Y, see 234Pu	-	3E+3	1E-6	4E-9	-	-
94	Plutonium-238	W, see 234Pu	9E-1	7E-3	3E-12	-	-	-
			Bone surf (2E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
		Y, see 234Pu	-	2E-2	8E-12	2E-14	-	-
94	Plutonium-239	W, see 234Pu	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
		Y, see 234Pu	-	2E-2	7E-12	-	-	-
			-	Bone surf (2E-2)	-	2E-14	-	-
94	Plutonium-240	W, see 234Pu	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
		Y, see 234Pu	-	2E-2	7E-12	-	-	-
			-	Bone surf (2E-2)	-	2E-14	-	-
94	Plutonium-241	W, see 234Pu	4E+1	3E-1	1E-10	-	-	-
			Bone surf (7E+1)	Bone surf (6E-1)	-	8E-13	1E-6	1E-5
		Y, see 234Pu	-	8E-1	3E-10	-	-	-
			-	Bone surf (1E+0)	-	1E-12	-	-
94	Plutonium-242	W, see 234Pu	8E-1	7E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
		Y, see 234Pu	-	2E-2	7E-12	-	-	-
			-	Bone surf (2E-2)	-	2E-14	-	-
94	Plutonium-243	W, see 234Pu	2E+4	4E+4	2E-5	5E-8	2E-4	2E-3
		Y, see 234Pu	-	4E+4	2E-5	5E-8	-	-
94	Plutonium-244	W, see 234Pu	8E-1	7E-3	3E-12	-	-	-
			Bone surf (2E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
		Y, see 234Pu	-	2E-2	7E-12	-	-	-
			-	Bone surf (2E-2)	-	2E-14	-	-
94	Plutonium-245	W, see 234Pu	2E+3	5E+3	2E-6	6E-9	3E-5	3E-4
		Y, see 234Pu	-	4E+3	2E-6	6E-9	-	-
94	Plutonium-246	W, see 234Pu	4E+2	3E+2	1E-7	4E-10	-	-
			LLI wall (4E+2)	-	-	-	6E-6	6E-5
		Y, see 234Pu	-	3E+2	1E-7	4E-10	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
95	Americium-237[2]	W, all compounds	8E+4	3E+5	1E-4	4E-7	1E-3	1E-2
95	Americium-238[2]	W, all compounds	4E+4	3E+3	1E-6	-	5E-4	5E-3
			-	Bone surf (6E+3)	-	9E-9	-	-
95	Americium-239	W, all compounds	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
95	Americium-240	W, all compounds	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
95	Americium-241	W, all compounds	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
95	Americium-242m	W, all compounds	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
95	Americium-242	W, all compounds	4E+3	8E+1	4E-8	-	5E-5	5E-4
			-	Bone surf (9E+1)	-	1E-10	-	-
95	Americium-243	W, all compounds	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
95	Americium-244m[2]	W, all compounds	6E+4	4E+3	2E-6	-	-	-
			St wall (8E+4)	Bone surf (7E+3)	-	1E-8	1E-3	1E-2
95	Americium-244	W, all compounds	3E+3	2E+2	8E-8	-	4E-5	4E-4
			-	Bone surf (3E+2)	-	4E-10	-	-
95	Americium-245	W, all compounds	3E+4	8E+4	3E-5	1E-7	4E-4	4E-3
95	Americium-246m[2]	W, all compounds	5E+4	2E+5	8E-5	3E-7	-	-
			St wall (6E+4)	-	-	-	8E-4	8E-3
95	Americium-246[2]	W, all compounds	3E+4	1E+5	4E-5	1E-7	4E-4	4E-3
96	Curium-238	W, all compounds	2E+4	1E+3	5E-7	2E-9	2E-4	2E-3
96	Curium-240	W, all compounds	6E+1	6E-1	2E-10	-	-	-
			Bone surf (8E+1)	Bone surf (6E-1)	-	9E-13	1E-6	1E-5
96	Curium-241	W, all compounds	1E+3	3E+1	1E-8	-	2E-5	2E-4
			-	Bone surf (4E+1)	-	5E-11	-	-
96	Curium-242	W, all compounds	3E+1	3E-1	1E-10	-	-	-
			Bone surf (5E+1)	Bone surf (3E-1)	-	4E-13	7E-7	7E-6
96	Curium-243	W, all compounds	1E+0	9E-3	4E-12	-	-	-
			Bone surf (2E+0)	Bone surf (2E-2)	-	2E-14	3E-8	3E-7
96	Curium-244	W, all compounds	1E+0	1E-2	5E-12	-	-	-
			Bone surf (3E+0)	Bone surf (2E-2)	-	3E-14	3E-8	3E-7
96	Curium-245	W, all compounds	7E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
96	Curium-246	W, all compounds	7E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
96	Curium-247	W, all compounds	8E-1	6E-3	3E-12	-	-	-
			Bone surf (1E+0)	Bone surf (1E-2)	-	2E-14	2E-8	2E-7
96	Curium-248	W, all compounds	2E-1	2E-3	7E-13	-	-	-
			Bone surf (4E-1)	Bone surf (3E-3)	-	4E-15	5E-9	5E-8
96	Curium-2492	W, all compounds	5E+4	2E+4	7E-6	-	7E-4	7E-3
			-	Bone surf (3E+4)	-	4E-8	-	-
96	Curium-250	W, all compounds	4E-2	3E-4	1E-13	-	-	-
			Bone surf (6E-2)	Bone surf (5E-4)	-	8E-16	9E-10	9E-9
97	Berkelium-245	W, all compounds	2E+3	1E+3	5E-7	2E-9	3E-5	3E-4
97	Berkelium-246	W, all compounds	3E+3	3E+3	1E-6	4E-9	4E-5	4E-4
97	Berkelium-247	W, all compounds	5E-1	4E-3	2E-12	-	-	-
			Bone surf (1E+0)	Bone surf (9E-3)	-	1E-14	2E-8	2E-7
97	Berkelium-249	W, all compounds	2E+2	2E+0	7E-10	-	-	-
			Bone surf (5E+2)	Bone surf (4E+0)	-	5E-12	6E-6	6E-5
97	Berkelium-250	W, all compounds	9E+3	3E+2	1E-7	-	1E-4	1E-3
			-	Bone surf (7E+2)	-	1E-9	-	-
98	Californium-244[2]	W, all compounds except those given for Y	3E+4	6E+2	2E-7	8E-10	-	-
			St wall (3E+4)	-	-	-	4E-4	4E-3
		Y, oxides and hydroxides	-	6E+2	2E-7	8E-10	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (µCi)	Table I Occupational Values Col. 2 Inhalation ALI (µCi)	Table I Occupational Values Col. 3 Inhalation DAC (µCi/ml)	Table II Effluent Concentrations Col. 1 Air (µCi/ml)	Table II Effluent Concentrations Col. 2 Water (µCi/ml)	Table III Releases to Sewers Monthly Average Concentration (µCi/ml)
98	Californium-246	W, see 244Cf	4E+2	9E+0	4E-9	1E-11	5E-6	5E-5
		Y, see 244Cf	-	9E+0	4E-9	1E-11	-	-
98	Californium-248	W, see 244Cf	8E+0	6E-2	3E-11	-	-	-
			Bone surf (2E+1)	Bone surf (1E-1)	-	2E-13	2E-7	2E-6
		Y, see 244Cf	-	1E-1	4E-11	1E-13	-	-
98	Californium-249	W, see 244Cf	5E-1	4E-3	2E-12	-	-	-
			Bone surf (1E+0)	Bone surf (9E-3)	-	1E-14	2E-8	2E-7
		Y, see 244Cf	-	1E-2	4E-12	-	-	-
			Bone surf -	(1E-2)	-	2E-14	-	-
98	Californium-250	W, see 244Cf	1E+0	9E-3	4E-12	-	-	-
			Bone surf (2E+0)	Bone surf (2E-2)	-	3E-14	3E-8	3E-7
		Y, see 244Cf	-	3E-2	1E-11	4E-14	-	-
98	Californium-251	W, see 244Cf	5E-1	4E-3	2E-12	-	-	-
			Bone surf (1E+0)	Bone surf (9E-3)	-	1E-14	2E-8	2E-7
		Y, see 244Cf	-	1E-2	4E-12	-	-	-
			Bone surf -	(1E-2)	-	2E-14	-	-
98	Californium-252	W, see 244Cf	2E+0	2E-2	8E-12	-	-	-
			Bone surf (5E+0)	Bone surf (4E-2)	-	5E-14	7E-8	7E-7
		Y, see 244Cf	-	3E-2	1E-11	5E-14	-	-
98	Californium-253	W, see 244Cf	2E+2	2E+0	8E-10	3E-12	-	-
			Bone surf (4E+2)	-	-	-	5E-6	5E-5
		Y, see 244Cf	-	2E+0	7E-10	2E-12	-	-
98	Californium-254	W, see 244Cf	2E+0	2E-2	9E-12	3E-14	3E-8	3E-7
		Y, see 244Cf	-	2E-2	7E-12	2E-14	-	-
99	Einsteinium-250	W, all compounds	4E+4	5E+2	2E-7	-	6E-4	6E-3
			-	Bone surf (1E+3)	-	2E-9	-	-
99	Einsteinium-251	W, all compounds	7E+3	9E+2	4E-7	-	1E-4	1E-3
			-	Bone surf (1E+3)	-	2E-9	-	-
99	Einsteinium-253	W, all compounds	2E+2	1E+0	6E-10	2E-12	2E-6	2E-5
99	Einsteinium-254m	W, all compounds	3E+2	1E+1	4E-9	1E-11	-	-
			LLI wall (3E+2)	-	-	-	4E-6	4E-5
99	Einsteinium-254	W, all compounds	8E+0	7E-2	3E-11	-	-	-
			Bone surf (2E+1)	Bone surf (1E-1)	-	2E-13	2E-7	2E-6
100	Fermium-252	W, all compounds	5E+2	1E+1	5E-9	2E-11	6E-6	6E-5
100	Fermium-253	W, all compounds	1E+3	1E+1	4E-9	1E-11	1E-5	1E-4
100	Fermium-254	W, all compounds	3E+3	9E+1	4E-8	1E-10	4E-5	4E-4
100	Fermium-255	W, all compounds	5E+2	2E+1	9E-9	3E-11	7E-6	7E-5
100	Fermium-257	W, all compounds	2E+1	2E-1	7E-11	-	-	-
			Bone surf (4E+1)	Bone surf (2E-1)	-	3E-13	5E-7	5E-6
101	Mendelevium-257	W, all compounds	7E+3	8E+1	4E-8	-	1E-4	1E-3
			-	Bone surf (9E+1)	-	1E-10	-	-
101	Mendelevium-258	W, all compounds	3E+1	2E-1	1E-10	-	-	-
			Bone surf (5E+1)	Bone surf (3E-1)	-	5E-13	6E-7	6E-6
-Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours Submersion[1]			-	2E+2	1E-7	1E-9	-	-
-Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than 2 hours			-	2E-1	1E-10	1E-12	1E-8	1E-7
-Any single radionuclide not listed above that decays by alpha emission or spontaneous fission, or any mixture for which either the identity or the concentration of any radionuclide in the mixture is not known			-	4E-4	2E-13	1E-15	2E-9	2E-8

FOOTNOTES:

1 "Submersion" means that values given are for submersion in a hemispherical semi-infinite cloud of airborne material.

2 These radionuclides have radiological half-lives of less than 2 hours. The total effective dose equivalent received during operations with these radionuclides might include a significant contribution from external exposure. The DAC values for all radionuclides, other than those designated Class "Submersion," are based upon the committed effective dose equivalent due to the intake of the radionuclide into the body and do NOT include potentially significant contributions to dose equivalent from external exposures. The licensee may substitute 1E-7 μCi/ml for the listed DAC to account for the submersion dose prospectively, but should use individual monitoring devices or other radiation measuring instruments that measure external exposure to demonstrate compliance with the limits. (See 20.1203.)

3 For soluble mixtures of U-238, U-234, and U-235 in air, chemical toxicity may be the limiting factor (see 20.1201(e)). If the percent by weight (enrichment) of U-235 is not greater than 5, the concentration value for a 40-hour workweek is 0.2 milligrams uranium per cubic meter of air average. For any enrichment, the product of the average concentration and time of exposure during a 40-hour workweek shall not exceed 8E-3 (SA) μCi-hr/ml, where SA is the specific activity of the uranium inhaled. The specific activity for natural uranium is 6.77E-7 curies per gram U. The specific activity for other mixtures of U-238, U-235, and U-234, if not known, shall be:

SA = 3.6E-7 curies/gram U U-depleted
SA = [0.4 + 0.38 (enrichment) + 0.0034 (enrichment)2] E-6 , enrichment $\geq$ 0.72
where enrichment is the percentage by weight of U-235, expressed as percent.

NOTES:

1. If the identity of each radionuclide in a mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture shall be the most restrictive DAC of any radionuclide in the mixture.

2. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in this appendix are not present in the mixture, the inhalation ALI, DAC, and effluent and sewage concentrations for the mixture are the lowest values specified in this appendix for any radionuclide that is not known to be absent from the mixture; or

		Table I				Table II		Table III
		Occupational Values				Effluent Concentrations		Releases to Sewers
		Col. 1	Col. 2	Col. 3		Col. 1	Col. 2	
		Oral Ingestion	Inhalation					Monthly Average
Atomic No.	Radionuclide	ALI (μCi)	ALI (μCi)	DAC (μCi/ml)		Air (μCi/ml)	Water (μCi/ml)	Concentration (μCi/ml)
	If it is known that Ac-227-D and Cm-250-W are not present	-	7E-4	3E-13		-	-	-
	If, in addition, it is known that Ac-227-W,Y, Th-229-W,Y, Th-230-W, Th-232-W,Y, Pa-231-W,Y, Np-237-W, Pu-239-W, Pu-240-W, Pu-242-W, Am-241-W, Am-242m-W, Am-243-W, Cm-245-W, Cm-246-W, Cm-247-W, Cm-248-W, Bk-247-W, Cf-249-W, and Cf-251-W are not present	-	7E-3	3E-12		-	-	-
	If, in addition, it is known that Sm-146-W, Sm-147-W, Gd-148-D,W, Gd-152-D,W, Th-228-W,Y, Th-230-Y, U-232-Y, U-233-Y, U-234-Y, U-235-Y, U-236-Y, U-238-Y, Np-236-W, Pu-236-W,Y, Pu-238-W,Y, Pu-239-Y, Pu-240-Y, Pu-242-Y, Pu-244-W,Y, Cm-243-W, Cm-244-W, Cf-248-W, Cf-249-Y, Cf-250-W,Y, Cf-251-Y, Cf-252-W,Y, and Cf-254-W,Y are not present	-	7E-2	3E-11		-	-	-

Atomic No.	Radionuclide	Class	Table I Occupational Values Col. 1 Oral Ingestion ALI (μCi)	Table I Occupational Values Col. 2 Inhalation ALI (μCi)	Table I Occupational Values Col. 3 Inhalation DAC (μCi/ml)	Table II Effluent Concentrations Col. 1 Air (μCi/ml)	Table II Effluent Concentrations Col. 2 Water (μCi/ml)	Table III Releases to Sewers Monthly Average Concentration (μCi/ml)
	If, in addition, it is known that Pb-210-D, Bi-210m-W, Po-210-D,W, Ra-223-W, Ra-225-W, Ra-226-W, Ac-225-D,W,Y, Th-227-W,Y, U-230-D,W,Y, U-232-D,W, Pu-241-W, Cm-240-W, Cm-242-W, Cf-248-Y, Es-254-W, Fm-257-W, and Md-258-W are not present		-	7E-1	3E-10	-	-	-
	If, in addition, it is known that Si-32-Y, Ti-44-Y, Fe-60-D, Sr-90-Y, Zr-93-D, Cd-113m-D, Cd-113-D, In-115-D,W, La-138-D, Lu-176-W, Hf-178m-D,W, Hf-182-D,W, Bi-210m-D, Ra-224-W, Ra-228-W, Ac-226-D,W,Y, Pa-230-W,Y, U-233-D,W, U-234-D,W, U-235-D,W, U-236-D,W, U-238-D,W, Pu-241-Y, Bk-249-W, Cf-253-W,Y, and Es-253-W are not present		-	7E+0	3E-9	-	-	-
	If it is known that Ac-227-D,W,Y, Th-229-W,Y, Th-232-W,Y, Pa-231-W,Y, Cm-248-W, and Cm-250-W are not present		-	-	-	1E-14	-	-
	If, in addition, it is known that Sm-146-W, Gd-148-D,W, Gd-152-D, Th-228-W,Y, Th-230-W,Y, U-232-Y, U-233-Y, U-234-Y, U-235-Y, U-236-Y, U-238-Y, U-Nat-Y, Np-236-W, Np-237-W, Pu-236-W,Y, Pu-238-W,Y, Pu-239-W,Y, Pu-240-W,Y, Pu-242-W,Y, Pu-244-W,Y, Am-241-W, Am-242m-W, Am-243-W, Cm-243-W, Cm-244-W, Cm-245-W, Cm-246-W, Cm-247-W, Bk-247-W, Cf-249-W,Y, Cf-250-W,Y, Cf-251-W,Y, Cf-252-W,Y, and Cf-254-W,Y are not present		-	-	-	1E-13	-	-
	If, in addition, it is known that Sm-147-W, Gd-152-W, Pb-210-D, Bi-210m-W, Po-210-D,W, Ra-223-W, Ra-225-W, Ra-226-W, Ac-225-D,W,Y, Th-227-W,Y, U-230-D,W,Y, U-232-D,W, U-Nat-W, Pu-241-W, Cm-240-W, Cm-242-W, Cf-248-W,Y, Es-254-W, Fm-257-W, and Md-258-W are not present		-	-	-	1E-12	-	-
	If, in addition it is known that Fe-60, Sr-90, Cd-113m, Cd-113, In-115, I-129, Cs-134, Sm-145, Sm-147, Gd-148, Gd-152, Hg-194 (organic), Bi-210m, Ra-223, Ra-224, Ra-225, Ac-225, Th-228, Th-230, U-233, U-234, U-235, U-236, U-238, U-Nat, Cm-242, Cf-248, Es-254, Fm-257, and Md-258 are not present		-	-	-	-	1E-6	1E-5

NOTES:

3. If a mixture of radionuclides consists of uranium and its daughters in ore dust (10 μm AMAD particle distribution assumed) prior to chemical separation of the uranium from the ore, the following values may be used for the DAC of the mixture: 6E-11 μCi of gross alpha activity from uranium-238, uranium-234, thorium-230, and radium-226 per milliliter of air; 3E-11 μCi of natural uranium per milliliter of air; or 45 micrograms of natural uranium per cubic meter of air.

4. If the identity and concentration of each radionuclide in a mixture are known, the limiting values should be derived as follows: determine, for each radionuclide in the mixture, the ratio between the concentration present in the mixture and the concentration otherwise established in Appendix B for the specific radionuclide when not in a mixture. The sum of such ratios for all of the radionuclides in the mixture may not exceed "1" (i.e., "unity").

   Example: If radionuclides "A," "B," and "C" are present in concentrations CA, CB, and CC, and if the applicable DACs are DACA, DACB, and DACC, respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_A}{DAC_A} + \frac{C_B}{DAC_B} + \frac{C_C}{DAC_C} \leq 1$$

APPENDIX C

QUANTITIES[1] OF LICENSED OR REGISTERED MATERIAL REQUIRING LABELING

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Hydrogen-3	1,000	Chromium-48	1,000
Beryllium-7	1,000	Chromium-49	1,000
Beryllium-10	1	Chromium-51	1,000
Carbon-11	1,000	Manganese-51	1,000
Carbon-14	100	Manganese-52m	1,000
Fluorine-18	1,000	Manganese-52	100
Sodium-22	10	Manganese-53	1,000
Sodium-24	100	Manganese-54	100
Magnesium-28	100	Manganese-56	1,000
Aluminum-26	10	Iron-52	100
Silicon-31	1,000	Iron-55	100
Silicon-32	1	Iron-59	10
Phosphorus-32	10	Iron-60	1
Phosphorus-33	100	Cobalt-55	100
Sulfur-35	100	Cobalt-56	10
Chlorine-36	10	Cobalt-57	100
Chlorine-38	1,000	Cobalt-58m	1,000
Chlorine-39	1,000	Cobalt-58	100
Argon-39	1,000	Cobalt-60m	1,000
Argon-41	1,000	Cobalt-60	1
Potassium-40	100	Cobalt-61	1,000
Potassium-42	1,000	Cobalt-62m	1,000
Potassium-43	1,000	Nickel-56	100
Potassium-44	1,000	Nickel-57	100
Potassium-45	1,000	Nickel-59	100
Calcium-41	100	Nickel-63	100
Calcium-45	100	Nickel-65	1,000
Calcium-47	100	Nickel-66	10
Scandium-43	1,000	Copper-60	1,000
Scandium-44m	100	Copper-61	1,000
Scandium-44	100	Copper-64	1,000
Scandium-46	10	Copper-67	1,000
Scandium-47	100	Zinc-62	100
Scandium-48	100	Zinc-63	1,000
Scandium-49	1,000	Zinc-65	10
Titanium-44	1	Zinc-69m	100
Titanium-45	1,000	Zinc-69	1,000
Vanadium-47	1,000	Zinc-71m	1,000
Vanadium-48	100	Zinc-72	100
Vanadium-49	1,000	Gallium-65	1,000

* To convert μCi to kBq, multiply the μCi value by 37.

QUANTITIES[1] OF LICENSED OR REGISTERED MATERIAL REQUIRING LABELING

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Gallium-66	100	Krypton-81	1,000
Gallium-67	1,000	Krypton-83m	1,000
Gallium-68	1,000	Krypton-85m	1,000
Gallium-70	1,000	Krypton-85	1,000
Gallium-72	100	Krypton-87	1,000
Gallium-73	1,000	Krypton-88	1,000
Germanium-66	1,000	Rubidium-79	1,000
Germanium-67	1,000	Rubidium-81m	1,000
Germanium-68	10	Rubidium-81	1,000
Germanium-69	1,000	Rubidium-82m	1,000
Germanium-71	1,000	Rubidium-83	100
Germanium-75	1,000	Rubidium-84	100
Germanium-77	1,000	Rubidium-86	100
Germanium-78	1,000	Rubidium-87	100
Arsenic-69	1,000	Rubidium-88	1,000
Arsenic-70	1,000	Rubidium-89	1,000
Arsenic-71	100	Strontium-80	100
Arsenic-72	100	Strontium-81	1,000
Arsenic-73	100	Strontium-83	100
Arsenic-74	100	Strontium-85m	1,000
Arsenic-76	100	Strontium-85	100
Arsenic-77	100	Strontium-87m	1,000
Arsenic-78	1,000	Strontium-89	10
Selenium-70	1,000	Strontium-90	0.1
Selenium-73m	1,000	Strontium-91	100
Selenium-73	100	Strontium-92	100
Selenium-75	100	Yttrium-86m	1,000
Selenium-79	100	Yttrium-86	100
Selenium-81m	1,000	Yttrium-87	100
Selenium-81	1,000	Yttrium-88	10
Selenium-83	1,000	Yttrium-90m	1,000
Bromine-74m	1,000	Yttrium-90	10
Bromine-74	1,000	Yttrium-91m	1,000
Bromine-75	1,000	Yttrium-91	10
Bromine-76	100	Yttrium-92	100
Bromine-77	1,000	Yttrium-93	100
Bromine-80m	1,000	Yttrium-94	1,000
Bromine-80	1,000	Yttrium-95	1,000
Bromine-82	100	Zirconium-86	100
Bromine-83	1,000	Zirconium-88	10
Bromine-84	1,000	Zirconium-89	100
Krypton-74	1,000	Zirconium-93	1
Krypton-76	1,000	Zirconium-95	10
Krypton-77	1,000	Zirconium-97	100
Krypton-79	1,000	Niobium-88	1,000

* To convert μCi to kBq, multiply the μCi value by 37.

QUANTITIES[1] OF LICENSED OR REGISTERED MATERIAL REQUIRING LABELING

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Niobium-89m (66 min)	1,000	Palladium-101	1,000
Niobium-89 (122 min)	1,000	Palladium-103	100
Niobium-90	100	Palladium-107	10
Niobium-93m	10	Palladium-109	100
Niobium-94	1	Silver-102	1,000
Niobium-95m	100	Silver-103	1,000
Niobium-95	100	Silver-104m	1,000
Niobium-96	100	Silver-104	1,000
Niobium-97	1,000	Silver-105	100
Niobium-98	1,000	Silver-106m	100
Molybdenum-90	100	Silver-106	1,000
Molybdenum-93m	100	Silver-108m	1
Molybdenum-93	10	Silver-110m	10
Molybdenum-99	100	Silver-111	100
Molybdenum-101	1,000	Silver-112	100
Technetium-93m	1,000	Silver-115	1,000
Technetium-93	1,000	Cadmium-104	1,000
Technetium-94m	1,000	Cadmium-107	1,000
Technetium-94	1,000	Cadmium-109	1
Technetium-96m	1,000	Cadmium-113m	0.1
Technetium-96	100	Cadmium-113	100
Technetium-97m	100	Cadmium-115m	10
Technetium-97	1,000	Cadmium-115	100
Technetium-98	10	Cadmium-117m	1,000
Technetium-99m	1,000	Cadmium-117	1,000
Technetium-99	100	Indium-109	1,000
Technetium-101	1,000	Indium-110m(69.1m)	1,000
Technetium-104	1,000	Indium-110 (4.9h)	1,000
Ruthenium-94	1,000	Indium-111	100
Ruthenium-97	1,000	Indium-112	1,000
Ruthenium-103	100	Indium-113m	1,000
Ruthenium-105	1,000	Indium-114m	10
Ruthenium-106	1	Indium-115m	1,000
Rhodium-99m	1,000	Indium-115	100
Rhodium-99	100	Indium-116m	1,000
Rhodium-100	100	Indium-117m	1,000
Rhodium-101m	1,000	Indium-117	1,000
Rhodium-101	10	Indium-119m	1,000
Rhodium-102m	10	Tin-110	100
Rhodium-102	10	Tin-111	1,000
Rhodium-103m	1,000	Tin-113	100
Rhodium-105	100	Tin-117m	100
Rhodium-106m	1,000	Tin-119m	100
Rhodium-107	1,000	Tin-121m	100
Palladium-100	100	Tin-121	1,000

* To convert μCi to kBq, multiply the μCi value by 37.

QUANTITIES[1] OF LICENSED OR REGISTERED MATERIAL REQUIRING LABELING

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Tin-123m	1,000	Iodine-120m	1,000
Tin-123	10	Iodine-120	100
Tin-125	10	Iodine-121	1,000
Tin-126	10	Iodine-123	100
Tin-127	1,000	Iodine-124	10
Tin-128	1,000	Iodine-125	1
Antimony-115	1,000	Iodine-126	1
Antimony-116m	1,000	Iodine-128	1,000
Antimony-116	1,000	Iodine-129	1
Antimony-117	1,000	Iodine-130	10
Antimony-118m	1,000	Iodine-131	1
Antimony-119	1,000	Iodine-132m	100
Antimony-120 (16m)	1,000	Iodine-132	100
Antimony-120 (5.76d)	100	Iodine-133	10
Antimony-122	100	Iodine-134	1,000
Antimony-124m	1,000	Iodine-135	100
Antimony-124	10	Xenon-120	1,000
Antimony-125	100	Xenon-121	1,000
Antimony-126m	1,000	Xenon-122	1,000
Antimony-126	100	Xenon-123	1,000
Antimony-127	100	Xenon-125	1,000
Antimony-128 (10.4m)	1,000	Xenon-127	1,000
Antimony-128 (9.O1h)	100	Xenon-129m	1,000
Antimony-129	100	Xenon-131m	1,000
Antimony-130	1,000	Xenon-133m	1,000
Antimony-131	1,000	Xenon-133	1,000
Tellurium-116	1,000	Xenon-135m	1,000
Tellurium-121m	10	Xenon-135	1,000
Tellurium-121	100	Xenon-138	1,000
Tellurium-123m	10	Cesium-125	1,000
Tellurium-123	100	Cesium-127	1,000
Tellurium-125m	10	Cesium-129	1,000
Tellurium-127m	10	Cesium-130	1,000
Tellurium-127	1,000	Cesium-131	1,000
Tellurium-129m	10	Cesium-132	100
Tellurium-129	1,000	Cesium-134m	1,000
Tellurium-131m	10	Cesium-134	10
Tellurium-131	100	Cesium-135m	1,000
Tellurium-132	10	Cesium-135	100
Tellurium-133m	100	Cesium-136	10
Tellurium-133	1,000	Cesium-137	10
Tellurium-134	1,000	Cesium-138	1,000

* To convert μCi to kBq, multiply the μCi value by 37.

QUANTITIES[1] OF LICENSED OR REGISTERED MATERIAL REQUIRING LABELING

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Barium-126	1,000	Promethium-141	1,000
Barium-128	100	Promethium-143	100
Barium-131m	1,000	Promethium-144	10
Barium-131	100	Promethium-145	10
Barium-133m	100	Promethium-146	1
Barium-133	100	Promethium-147	10
Barium-135m	100	Promethium-148m	10
Barium-139	1,000	Promethium-148	10
Barium-140	100	Promethium-149	100
Barium-141	1,000	Promethium-150	1,000
Barium-142	1,000	Promethium-151	100
Lanthanum-131	1,000	Samarium-141m	1,000
Lanthanum-132	100	Samarium-141	1,000
Lanthanum-135	1,000	Samarium-142	1,000
Lanthanum-137	10	Samarium-145	100
Lanthanum-138	100	Samarium-146	1
Lanthanum-140	100	Samarium-147	100
Lanthanum-141	100	Samarium-151	10
Lanthanum-142	1,000	Samarium-153	100
Lanthanum-143	1,000	Samarium-155	1,000
Cerium-134	100	Samarium-156	1,000
Cerium-135	100	Europium-145	100
Cerium-137m	100	Europium-146	100
Cerium-137	1,000	Europium-147	100
Cerium-139	100	Europium-148	10
Cerium-141	100	Europium-149	100
Cerium-143	100	Europium-150 (12.62h)	100
Cerium-144	1	Europium-150 (34.2y)	1
Praseodymium-136	1,000	Europium-152m	100
Praseodymium-137	1,000	Europium-152	1
Praseodymium-138m	1,000	Europium-154	1
Praseodymium-139	1,000	Europium-155	10
Praseodymium-142m	1,000	Europium-156	100
Praseodymium-142	100	Europium-157	100
Praseodymium-143	100	Europium-158	1,000
Praseodymium-144	1,000	Gadolinium-145	1,000
Praseodymium-145	100	Gadolinium-146	10
Praseodymium-147	1,000	Gadolinium-147	100
Neodymium-136	1,000	Gadolinium-148	0.001
Neodymium-138	100	Gadolinium-149	100
Neodymium-139m	1,000	Gadolinium-151	10
Neodymium-139	1,000	Gadolinium-152	100
Neodymium-141	1,000	Gadolinium-153	10
Neodymium-147	100	Gadolinium-159	100
Neodymium-149	1,000		
Neodymium-151	1,000		

* To convert μCi to kBq, multiply the μCi value by 37.

QUANTITIES[1] OF LICENSED OR REGISTERED MATERIAL REQUIRING LABELING

Radionuclide	Quantity (µCi)*	Radionuclide	Quantity (µCi)*
Terbium-147	1,000	Ytterbium-167	1,000
Terbium-149	100	Ytterbium-169	100
Terbium-150	1,000	Ytterbium-175	100
Terbium-151	100	Ytterbium-177	1,000
Terbium-153	1,000	Ytterbium-178	1,000
Terbium-154	100	Lutetium-169	100
Terbium-155	1,000	Lutetium-170	100
Terbium-156m (5.Oh)	1,000	Lutetium-171	100
Terbium-156m (24.4h)	1,000	Lutetium-172	100
Terbium-156	100	Lutetium-173	10
Terbium-157	10	Lutetium-174m	10
Terbium-158	1	Lutetium-174	10
Terbium-160	10	Lutetium-176m	1,000
Terbium-161	100	Lutetium-176	100
Dysprosium-155	1,000	Lutetium-177m	10
Dysprosium-157	1,000	Lutetium-177	100
Dysprosium-159	100	Lutetium-178m	1,000
Dysprosium-165	1,000	Lutetium-178	1,000
Dysprosium-166	100	Lutetium-179	1,000
Holmium-155	1,000	Hafnium-170	100
Holmium-157	1,000	Hafnium-172	1
Holmium-159	1,000	Hafnium-173	1,000
Holmium-161	1,000	Hafnium-175	100
Holmium-162m	1,000	Hafnium-177m	1,000
Holmium-162	1,000	Hafnium-178m	0.1
Holmium-164m	1,000	Hafnium-179m	10
Holmium-164	1,000	Hafnium-180m	1,000
Holmium-166m	1	Hafnium-181	10
Holmium-166	100	Hafnium-182m	1,000
Holmium-167	1,000	Hafnium-182	0.1
Erbium-161	1,000	Hafnium-183	1,000
Erbium-165	1,000	Hafnium-184	100
Erbium-169	100	Tantalum-172	1,000
Erbium-171	100	Tantalum-173	1,000
Erbium-172	100	Tantalum-174	1,000
Thulium-162	1,000	Tantalum-175	1,000
Thulium-166	100	Tantalum-176	100
Thulium-167	100	Tantalum-177	1,000
Thulium-170	10	Tantalum-178	1,000
Thulium-171	10	Tantalum-179	100
Thulium-172	100	Tantalum-180m	1,000
Thulium-173	100	Tantalum-180	100
Thulium-175	1,000	Tantalum-182m	1,000
Ytterbium-162	1,000	Tantalum-182	10
Ytterbium-166	100	Tantalum-183	100
		Tantalum-184	100
		Tantalum-185	1,000

* To convert µCi to kBq, multiply the µCi value by 37.

QUANTITIES[1] OF LICENSED OR REGISTERED MATERIAL REQUIRING LABELING

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Tantalum-186	1,000	Iridium-195m	1,000
Tungsten-176	1,000	Iridium-195	1,000
Tungsten-177	1,000	Platinum-186	1,000
Tungsten-178	1,000	Platinum-188	100
Tungsten-179	1,000	Platinum-189	1,000
Tungsten-181	1,000	Platinum-191	100
Tungsten-185	100	Platinum-193m	100
Tungsten-187	100	Platinum-193	1,000
Tungsten-188	10	Platinum-195m	100
Rhenium-177	1,000	Platinum-197m	1,000
Rhenium-178	1,000	Platinum-197	100
Rhenium-181	1,000	Platinum-199	1,000
Rhenium-182 (12.7h)	1,000	Platinum-200	100
Rhenium-182 (64.Oh)	100	Gold-193	1,000
Rhenium-184m	10	Gold-194	100
Rhenium-184	100	Gold-195	10
Rhenium-186m	10	Gold-198m	100
Rhenium-186	100	Gold-198	100
Rhenium-187	1,000	Gold-199	100
Rhenium-188m	1,000	Gold-200m	100
Rhenium-188	100	Gold-200	1,000
Rhenium-189	100	Gold-201	1,000
Osmium-180	1,000	Mercury-193m	100
Osmium-181	1,000	Mercury-193	1,000
Osmium-182	100	Mercury-194	1
Osmium-185	100	Mercury-195m	100
Osmium-189m	1,000	Mercury-195	1,000
Osmium-191m	1,000	Mercury-197m	100
Osmium-191	100	Mercury-197	1,000
Osmium-193	100	Mercury-199m	1,000
Osmium-194	1	Mercury-203	100
Iridium-182	1,000	Thallium-194m	1,000
Iridium-184	1,000	Thallium-194	1,000
Iridium-185	1,000	Thallium-195	1,000
Iridium-186	100	Thallium-197	1,000
Iridium-187	1,000	Thallium-198m	1,000
Iridium-188	100	Thallium-198	1,000
Iridium-189	100	Thallium-199	1,000
Iridium-190m	1,000	Thallium-200	1,000
Iridium-190	100	Thallium-201	1,000
Iridium-192 (73.8d)	1	Thallium-202	100
Iridium-192m (1.4m)	10	Thallium-204	100
Iridium-194m	10	Lead-195m	1,000
Iridium-194	100	Lead-198	1,000

* To convert μCi to kBq, multiply the μCi value by 37.

QUANTITIES[1] OF LICENSED OR REGISTERED MATERIAL REQUIRING LABELING

Radionuclide	Quantity (µCi)*	Radionuclide	Quantity (µCi)*
Lead-199	1,000	Thorium-226	10
Lead-200	100	Thorium-227	0.01
Lead-201	1,000	Thorium-228	0.001
Lead-202m	1,000	Thorium-229	0.001
Lead-202	10	Thorium-230	0.001
Lead-203	1,000	Thorium-231	100
Lead-205	100	Thorium-232	100
Lead-209	1,000	Thorium-234	10
Lead-210	0.01	Thorium-natural	100
Lead-211	100	Protactinium-227	10
Lead-212	1	Protactinium-228	1
Lead-214	100	Protactinium-230	0.1
Bismuth-200	1,000	Protactinium-231	0.001
Bismuth-201	1,000	Protactinium-232	1
Bismuth-202	1,000	Protactinium-233	100
Bismuth-203	100	Protactinium-234	100
Bismuth-205	100	Uranium-230	0.01
Bismuth-206	100	Uranium-231	100
Bismuth-207	10	Uranium-232	0.001
Bismuth-210m	0.1	Uranium-233	0.001
Bismuth-210	1	Uranium-234	0.001
Bismuth-212	10	Uranium-235	0.001
Bismuth-213	10	Uranium-236	0.001
Bismuth-214	100	Uranium-237	100
Polonium-203	1,000	Uranium-238	100
Polonium-205	1,000	Uranium-239	1,000
Polonium-207	1,000	Uranium-240	100
Polonium-210	0.1	Uranium-natural	100
Astatine-207	100	Neptunium-232	100
Astatine-211	10	Neptunium-233	1,000
Radon-220	1	Neptunium-234	100
Radon-222	1	Neptunium-235	100
Francium-222	100	Neptunium-236 (1.15E+5)	0.001
Francium-223	100	Neptunium-236 (22.5h)	1
Radium-223	0.1	Neptunium-237	0.001
Radium-224	0.1	Neptunium-238	10
Radium-225	0.1	Neptunium-239	100
Radium-226	0.1	Neptunium-240	1,000
Radium-227	1,000	Plutonium-234	10
Radium-228	0.1	Plutonium-235	1,000
Actinium-224	1	Plutonium-236	0.001
Actinium-225	0.01	Plutonium-237	100
Actinium-226	0.1		
Actinium-227	0.001		
Actinium-228	1		

* To convert µCi to kBq, multiply the µCi value by 37.

QUANTITIES[1] OF LICENSED OR REGISTERED MATERIAL REQUIRING LABELING

Radionuclide	Quantity (μCi)*	Radionuclide	Quantity (μCi)*
Plutonium-238	0.001	Curium-247	0.001
Plutonium-239	0.001	Curium-248	0.001
Plutonium-240	0.001	Curium-249	1,000
Plutonium-241	0.01	Berkelium-245	100
Plutonium-242	0.001	Berkelium-246	100
Plutonium-243	1,000	Berkelium-247	0.001
Plutonium-244	0.001	Berkelium-249	0.1
Plutonium-245	100	Berkelium-250	10
Americium-237	1,000	Californium-244	100
Americium-238	100	Californium-246	1
Americium-239	1,000	Californium-248	0.01
Americium-240	100	Californium-249	0.001
Americium-241	0.001	Californium-250	0.001
Americium-242m	0.001	Californium-251	0.001
Americium-242	10	Californium-252	0.001
Americium-243	0.001	Californium-253	0.1
Americium-244m	100	Californium-254	0.001
Americium-244	10	Einsteinium-250	100
Americium-245	1,000	Einsteinium-251	100
Americium-246m	1,000	Einsteinium-253	0.1
Americium-246	1,000	Einsteinium-254m	1
Curium-238	100	Einsteinium-254	0.01
Curium-240	0.1	Fermium-252	1
Curium-241	1	Fermium-253	1
Curium-242	0.01	Fermium-254	10
Curium-243	0.001	Fermium-255	1
Curium-244	0.001	Fermium-257	0.01
Curium-245	0.001	Mendelevium-257	10
Curium-246	0.001	Mendelevium-258	0.01
Any alpha-emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition	0.001	Any radionuclide other than alpha-emitting radionuclides not listed above, or mixtures of beta emitters of unknown composition	0.01

* To convert μCi to kBq, multiply the μCi value by 37.

NOTE: For purposes of D.28.E, D.31.A, and D.51.A where there is involved a combination of radionuclides in known amounts, the limit for the combination shall be derived as follows: determine, for each radionuclide in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific radionuclide when not in combination. The sum of such ratios for all radionuclides in the combination may not exceed "1" -- that is, unity.

[1]The quantities listed above were derived by taking 1/10th of the most restrictive ALI listed in Table I, Columns 1 and 2, of Appendix B to Part D, rounding to the nearest factor of 10, and constraining the values listed between 37 Bq and 37 MBq (0.001 and 1,000 μCi). Values of 3.7 MBq (100 μCi) have been assigned for radionuclides having a radioactive half- life in excess of E+9 years, except rhenium, 37 MBq (1,000 μCi), to take into account their low specific activity.

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APPENDIX D

Requirements for Transfers of Low-Level Radioactive Waste Intended for Disposal at Licensed Land Disposal Facilities and Manifests

I. Manifest

A. A waste generator, collector, or processor who transports, or offers for transportation, low-level radioactive waste intended for ultimate disposal at a licensed low-level radioactive waste land disposal facility must prepare a Manifest reflecting information requested on applicable Agency Forms (or other equivalent NRC, Licensing State or Agreement State approved forms) HHE-846 (Uniform Low-Level Radioactive Waste Manifest (Shipping Paper)) and HHE-847 (Uniform Low-Level Radioactive Waste Manifest (Container and Waste Description)) and, if necessary, on an applicable Agency Form HHE-848 (Uniform Low-Level Radioactive Waste Manifest (Manifest Index and Regional Compact Tabulation)). Agency Forms HHE-846 and HHE-846A must be completed and must physically accompany the pertinent low-level waste shipment. Upon agreement between shipper and consignee, Agency Forms HHE-847, HHE-847A, HHE-848 and HHE-848A may be completed, transmitted, and stored in electronic media with the capability for producing legible, accurate, and complete records on the respective forms. Licensees are not required by Agency to comply with the manifesting requirements of this part when they ship:

1. LLW for processing and expect its return (i.e., for storage under their license) prior to disposal at a licensed land disposal facility;

2. LLW that is being returned to the licensee who is the "waste generator" or "generator," as defined in this part; or

3. Radioactively contaminated material to a "waste processor" that becomes the processor's "residual waste."

B. For guidance in completing these forms, refer to the instructions that accompany the forms. Copies of manifests required by this appendix may be legible carbon copies, photocopies, or computer printouts that reproduce the data in the format of the uniform manifest.

C. Agency Forms HHE-846, HHE-846A, HHE-847, HHE-847A, HHE-848 and HHE-848A, and the accompanying instructions, in hard copy, may be obtained from the Maine Radiation Control Program, 11 State House Station, Augusta, Maine 04333-0011

D. This appendix includes information requirements of the Department of Transportation, as codified in 49 CFR part 172. Information on hazardous, medical, or other waste, required to meet Environmental Protection Agency regulations, as codified in 40 CFR parts 259, 261 or elsewhere, is not addressed in this section, and must be provided on the required EPA forms. However, the required EPA forms must accompany the Uniform Low-Level Radioactive Waste Manifest required by this appendix.

E. As used in this appendix, the following definitions apply:

1. **Agency Forms HHE-846, HHE-846A, HHE-847, HHE-847A, HHE-848 and HHE-848A** are official Agency Forms referenced in this appendix. Licensees need not use originals of these Agency Forms as long as any substitute forms are equivalent to the original documentation in respect to content, clarity, size, and location of information. Upon agreement between the shipper and consignee, Agency Forms HHE-847 (and HHE-847A) and Agency Forms HHE-848 (and HHE-848A) may be completed, transmitted, and stored in electronic media. The electronic media must have the capability for producing legible, accurate, and complete records in the format of the uniform manifest.

2. **Chemical description** means a description of the principal chemical characteristics of a low-level radioactive waste.

3. **Computer-readable medium** means that the regulatory agency's computer can transfer the information from the medium into its memory.

4. **Consignee** means the designated receiver of the shipment of low-level radioactive waste.

5. **Decontamination facility** means a facility operating under a Commission or Agreement State license whose principal purpose is decontamination of equipment or materials to accomplish recycle, reuse, or other waste management objectives, and, for purposes of this part, is not considered to be a consignee for LLW shipments.

6. **Disposal container** means a container principally used to confine low-level radioactive waste during disposal operations at a land disposal facility (also see "high integrity container"). Note that for some shipments, the disposal container may be the transport package.

7. **EPA identification number** means the number received by a transporter following application to the Administrator of EPA as required by 40 CFR part 263.

8. **Generator** means a licensee operating under a Commission or Agreement State license who:

   (a) is a waste generator as defined in this part, or

   (b) is the licensee to whom waste can be attributed within the context of the Low-Level Radioactive Waste Policy Amendments Act of 1985 (e.g., waste generated as a result of decontamination or recycle activities).

9. **High integrity container (HIC)** means a container commonly designed to meet the structural stability requirements of section V of this appendix, and to meet Department of Transportation requirements for a Type A package.

10. **Land disposal facility** means the land, buildings and structures, and equipment, which are intended to be used for the disposal of radioactive wastes. For purposes of this chapter, a "geologic repository" is not considered a "land disposal facility.

11. **Package** means the assembly of components necessary to ensure compliance with the packaging requirements of DOT regulations, together with its radioactive contents, as presented for transport.

12. **Physical description** means the items called for on Agency Form HHE-847 to describe a low-level radioactive waste.

13. **Residual waste** means low-level radioactive waste resulting from processing or decontamination activities that cannot be easily separated into distinct batches attributable to specific waste generators. This waste is attributable to the processor or decontamination facility, as applicable.

14. **Shipper** means the licensed entity (i.e., the waste generator, waste collector, or waste processor) who offers low-level radioactive waste for transportation, typically consigning this type of waste to a licensed waste collector, waste processor, or land disposal facility operator.

15. **Shipping paper** means Agency Form HHE-846 and, if required, Agency Form HHE-846A, which includes the information, required by DOT in 49 CFR part 172.

16. **Uniform Low-Level Radioactive Waste Manifest *or* uniform manifest** means the combination of Agency Forms HHE-846, HHE-847, and, if necessary, HHE-848, and their respective continuation sheets as needed, or equivalent.

17. **Waste collector** means an entity, operating under a Commission or Agreement State license, whose principal purpose is to collect and consolidate waste generated by others, and to transfer this waste, without processing or repackaging the collected waste, to another licensed waste collector, licensed waste processor, or licensed land disposal facility.

18. **Waste description** means the physical, chemical and radiological description of a low-level radioactive waste as called for on Agency Form HHE-847.

19. **Waste generator** means an entity, operating under a Commission or Agreement State license, who

    (a) possesses any material or component that contains radioactivity or is radioactively contaminated for which the licensee foresees no further use, and

    (b) transfers this material or component to a licensed land disposal facility or to a licensed waste collector or processor for handling or treatment prior to disposal. A licensee performing processing or decontamination services may be a "waste generator" if the transfer of low-level radioactive waste from its facility is defined as "residual waste."

20. **Waste processor** means an entity, operating under a Commission or Agreement State license, whose principal purpose is to process, repackage, or otherwise treat low-level radioactive material or waste generated by others prior to eventual transfer of waste to a licensed low-level radioactive waste land disposal facility.

21. **Waste type** means a waste within a disposal container having a unique physical description (i.e., a specific waste descriptor code or description; or a waste sorbed on or solidified in a specifically defined media).

II. Information Requirements

A. General Information: The shipper of the radioactive waste, shall provide the following information on the uniform manifest:

1. The name, facility address, and telephone number of the licensee shipping the waste;

2. An explicit declaration indicating whether the shipper is acting as a waste generator, collector, processor, or a combination of these identifiers for purposes of the manifested shipment; and

3. The name, address, and telephone number, or the name and EPA identification number for the carrier transporting the waste.

B. Shipment Information: The shipper of the radioactive waste shall provide the following information regarding the waste shipment on the uniform manifest:

1. The date of the waste shipment;

2. The total number of packages/disposal containers;

3. The total disposal volume and disposal weight in the shipment;

4. The total radionuclide activity in the shipment;

5. The activity of each of the radionuclides H-3, C-14, Tc-99, and I-129 contained in the shipment; and

6. The total masses of U-233, U-235, and plutonium in special nuclear material, and the total mass of uranium and thorium in source material.

C. Disposal Container and Waste Information: The shipper of the radioactive waste shall provide the following information on the uniform manifest regarding the waste and each disposal container of waste in the shipment:

1. An alphabetic or numeric identification that uniquely identifies each disposal container in the shipment;

2. A physical description of the disposal container, including the manufacturer and model of any high integrity container;

3. The volume displaced by the disposal container;

4. The gross weight of the disposal container, including the waste;

5. For waste consigned to a disposal facility, the maximum radiation level at the surface of each disposal container;

6. A physical and chemical description of the waste;

7. The total weight percentage of chelating agent for any waste containing more than 0.1% chelating agent by weight, plus the identity of the principal chelating agent;

8. The approximate volume of waste within a container;

9. The absorbing or solidification media, if any, and the identity of the solidification media vendor and brand name;

10. The identities and activities of individual radionuclides contained in each container, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material. For discrete waste types (i.e., activated materials, contaminated equipment, mechanical filters, sealed source/devices, and wastes in solidification/stabilization media), the identities and activities of individual radionuclides associated with or contained on these waste types within a disposal container shall be reported;

11. The total radioactivity within each container; and

12. For wastes consigned to a disposal facility, the classification of the waste pursuant to section V of this appendix. Waste not meeting the structural stability requirements of section VI.B. of this appendix must be identified.

D. Uncontainerized Waste Information: The shipper of the radioactive waste shall provide the following information on the uniform manifest regarding a waste shipment delivered without a disposal container:

1. The approximate volume and weight of the waste;

2. A physical and chemical description of the waste;

3. The total weight percentage of chelating agent if the chelating agent exceeds 0.1% by weight, plus the identity of the principal chelating agent;

4. For waste consigned to a disposal facility, the classification of the waste pursuant to section V. of this appendix. Waste not meeting the structural stability requirements of section VI.B. of this appendix must be identified;

5. The identities and activities of individual radionuclides contained in the waste, the masses of U - 233, U - 235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material; and

6. For wastes consigned to a disposal facility, the maximum radiation levels at the surface of the waste.

E. Multi-Generator Disposal Container Information: This section applies to disposal containers enclosing mixtures of waste originating from different generators. (Note: The origin of the LLW resulting from a processor's activities may be attributable to one or more "generators" (including "waste generators") as defined in this part). It also applies to mixtures of wastes shipped in an uncontainerized form, for which portions of the mixture within the shipment originate from different generators.

1. For homogeneous mixtures of waste, such as incinerator ash, provide the waste description applicable to the mixture and the volume of the waste attributed to each generator.

2. For heterogeneous mixtures of waste, such as the combined products from a large compactor, identify each generator contributing waste to the disposal container, and, for discrete waste types (i.e., activated materials, contaminated equipment, mechanical filters, sealed source/devices, and wastes in solidification/stabilization media), the identities and activities of individual radionuclides contained on these waste types within the disposal container. For each generator, provide the following:

(a) The volume of waste within the disposal container;

(b) A physical and chemical description of the waste, including the solidification agent, if any;

(c) The total weight percentage of chelating agents for any disposal container containing more than 0.1% chelating agent by weight, plus the identity of the principal chelating agent;

(d) The absorbing or solidification media, if any, and the identity of the solidification media vendor and brand name if the media is claimed to meet stability requirements in section VI.B. of this appendix; and

(e) Radionuclide identities and activities contained in the waste, the masses of U-233, U-235, and plutonium in special nuclear material, and the masses of uranium and thorium in source material if contained in the waste.

III. Certification: An authorized representative of the waste generator, processor, or collector shall certify by signing and dating the shipment manifest that the transported materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation and the Agency. A collector in signing the certification is certifying that nothing has been done to the collected waste, which would invalidate the waste generator's certification.

IV. Control and Tracking:

A. Any licensee or registrant who transfers radioactive waste to a land disposal facility or a licensed waste collector shall comply with the requirements in paragraphs A.1 through 9 of this section. Any licensee or registrant who transfers waste to a licensed waste processor for waste treatment or repackaging shall comply with the requirements of paragraphs A.4 through 9 of this appendix. A licensee shall:

1. Prepare all wastes so that the waste is classified according to section V. of this appendix and meets the waste characteristics requirements in section VI. of this appendix;

2. Label each disposal container (or transport package if potential radiation hazards preclude labeling of the individual disposal container) of waste to identify whether it is Class A waste, Class B waste, Class C waste, or greater then Class C waste, in accordance with section V. of this appendix;

3. Conduct a quality assurance program to assure compliance with sections V. and VI. of this appendix (the program must include management evaluation of audits);

4. Prepare the Agency Uniform Low-Level Radioactive Waste Manifest as required by this appendix;

5. Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either

   (a) receipt of the manifest precedes the LLW shipment or

   (b) the manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (a) and (b) is also acceptable;

6. Include Agency Form HHE-846 (and Agency Form HHE-846A, if required) with the shipment regardless of the option chosen in paragraph A.5 of this section;

7. Receive acknowledgement of the receipt of the shipment in the form of a signed copy of Agency Form HHE-846;

8. Retain a copy of or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by these regulations; and

9. For any shipments or any part of a shipment for which acknowledgement of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this appendix.

B. Any waste collector licensee who handles only prepackaged waste shall:

1. Acknowledge receipt of the waste from the shipper within one week of receipt by returning a signed copy of Agency Form HHE-846;

2. Prepare a new manifest to reflect consolidated shipments that meet the requirements of this appendix. The waste collector shall ensure that, for each container of waste in the shipment, the manifest identifies the generator of that container of waste;

3. Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either:

   (a) Receipt of the manifest precedes the LLW shipment or

   (b) the manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (a) and (b) is also acceptable;

4. Include Agency Form HHE-846 (and Agency Form HHE-846A, if required) with the shipment regardless of the option chosen in paragraph B.3 of this section;

5. Receive acknowledgement of the receipt of the shipment in the form of a signed copy of Agency Form HHE-846;

6. Retain a copy of or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by these regulations;

7. For any shipments or any part of a shipment for which acknowledgement of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this section; and

8. Notify the shipper and the Agency when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been cancelled.

C. Any licensed waste processor who treats or repackages waste shall:

1. Acknowledge receipt of the waste from the shipper within one week of receipt by returning a signed copy of Agency Form HHE-846;

2. Prepare a new manifest that meets the requirements of this appendix. Preparation of the new manifest reflects that the processor is responsible for meeting these requirements. For each container of waste in the shipment, the manifest shall identify the waste generators, the preprocessed waste volume, and the other information as required in paragraph I.E. of this appendix;

3. Prepare all wastes so that the waste is classified according to section V. of this appendix and meets the waste characteristics requirements in section VI. of this appendix;

4. Label each package of waste to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with sections V. and VI. of this appendix;

5. Conduct a quality assurance program to assure compliance with sections V. and VI. of this appendix (the program shall include management evaluation of audits);

6. Forward a copy or electronically transfer the Uniform Low-Level Radioactive Waste Manifest to the intended consignee so that either:

(a) Receipt of the manifest precedes the LLW shipment or

(b) the manifest is delivered to the consignee with the waste at the time the waste is transferred to the consignee. Using both (a) and (b) is also acceptable;

7. Include Agency Forms HHE-846 (and Agency Forms HHE-846A, if required) with the shipment regardless of the option chosen in paragraph C.6 of this section;

8. Receive acknowledgement of the receipt of the shipment in the form of a signed copy of Agency Forms HHE-846;

9. Retain a copy of or electronically store the Uniform Low-Level Radioactive Waste Manifest and documentation of acknowledgement of receipt as the record of transfer of licensed material as required by these regulations;

10. For any shipment or any part of a shipment for which acknowledgement of receipt has not been received within the times set forth in this appendix, conduct an investigation in accordance with paragraph E of this section; and

11. Notify the shipper and the Agency when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been cancelled.

D. The land disposal facility operator shall:

1. Acknowledge receipt of the waste within one week of receipt by returning, as a minimum, a signed copy of Agency Forms HHE-846 to the shipper. The shipper to be notified is the licensee who last possessed the waste and transferred the waste to the operator. If any discrepancy exists between materials listed on the Uniform Low-Level Radioactive Waste Manifest and materials received, copies or electronic transfer of the affected forms must be returned indicating the discrepancy;

2. Maintain copies of all completed manifests and electronically store the information required by this Appendix until the Agency terminates the license; and

3. Notify the shipper and the Agency when any shipment, or part of a shipment, has not arrived within 60 days after receipt of an advance manifest, unless notified by the shipper that the shipment has been cancelled.

E. Any shipment or part of a shipment for which acknowledgement is not received within the times set forth in this section must:

1. Be investigated by the shipper if the shipper has not received notification or receipt within 20 days after transfer; and

2. Be traced and reported. The investigation shall include tracing the shipment and filing a report with the Agency. Each licensee who conducts a trace investigation shall file a written report with the Agency within 2 weeks of completion of the investigation.

V. Classification of Waste

A. Classification of waste for near surface disposal.

1. **Considerations**: Determination of the classification of radioactive waste involves two considerations. First, consideration must be given to the concentration of long-lived radionuclides (and their shorter-lived precursors) whose potential hazard will persist long after such precautions as institutional controls, improved waste form, and deeper disposal have ceased to be effective. These precautions delay the time when long-lived radionuclides could cause exposures. In addition, the magnitude of the potential dose is limited by the concentration and availability of the radionuclide at the time of exposure. Second, consideration must be given to the concentration of shorter-lived radionuclides for which requirements on institutional controls, waste form, and disposal methods are effective.

2. **Classes of waste**.

(a) Class A waste is waste that is usually segregated from other waste classes at the disposal site. The physical form and characteristics of Class A waste must meet the minimum requirements set forth in VI.A. of this appendix. If Class A waste also meets the stability requirements set forth in VI.B. of this appendix, it is not necessary to segregate the waste for disposal.

(b) Class B waste is waste that must meet more rigorous requirements on waste form to ensure stability after disposal. The physical form and characteristics of Class B waste must meet both the minimum and stability requirements set forth in section VI of this appendix.

(c) Class C waste is waste that not only must meet more rigorous requirements on waste form to ensure stability but also requires additional measures at the disposal facility to protect against inadvertent intrusion. The physical form and characteristics of Class C waste must meet both the minimum and stability requirements set forth in section VI of this appendix.

(d) Waste that is not generally acceptable for near-surface disposal is waste for which form and disposal methods must be different, and in general more stringent, than those specified for Class C waste. In the absence of specific requirements in this part, such waste must be disposed of in a geologic repository as defined in 10 CFR part 60 unless proposals for disposal of such waste in a disposal site licensed pursuant to 10 CFR Part 61 are approved by the Nuclear Regulatory Commission.

3. **Classification determined by long-lived radionuclides.** If radioactive waste contains only radionuclides listed in Table 1, classification shall be determined as follows:

(a) If the concentration does not exceed 0.1 times the value in Table 1, the waste is Class A.

(b) If the concentration exceeds 0.1 times the value in Table 1 but does not exceed the value in Table 1, the waste is Class C.

(c) If the concentration exceeds the value in Table 1, the waste is not generally acceptable for near-surface disposal.

(d) For wastes containing mixtures of radionuclides listed in Table 1, the total concentration shall be determined by the sum of fractions.

Table 1	
Radionuclide	**Concentration curies per cubic meter**
C-14	8
C-14 in activated metal	80
Ni-59 in activated metal	220
Nb-94 in activated metal	0.2
Tc-99	3
I-129	0.08
Alpha emitting transuranic nuclides with half-life greater than 5 years	[1]100
Pu-241	[1]3,500
Cm-242	[1]20,000

[1]Units are nanocuries per gram.

4. **Classification determined by short-lived radionuclides**. If radioactive waste does not contain any of the radionuclides listed in Table 1, classification shall be determined based on the concentrations shown in Table 2. However, as specified in paragraph A.6. of this section, if radioactive waste does not contain any nuclides listed in either Table 1 or 2, it is Class A.

(a) If the concentration does not exceed the value in Column 1, the waste is Class A.

(b) If the concentration exceeds the value in Column 1, but does not exceed the value in Column 2, the waste is Class B.

(c) If the concentration exceeds the value in Column 2, but does not exceed the value in Column 3, the waste is Class C.

(d) If the concentration exceeds the value in Column 3, the waste is not generally acceptable for near-surface disposal.

(e) For wastes containing mixtures of the nuclides listed in Table 2, the total concentration shall be determined by the sum of fractions rule

Table 2			
Radionuclide	**Concentration, curies per cubic meter**		
	Col. 1	**Col. 2**	**Col. 3**
Total of all nuclides with less than 5 year half-life	700	([1])	([1])
H-3	40	([1])	([1])
Co-60	700	([1])	([1])
Ni-63	3.5	70	700
Ni-63 in activated metal	35	700	7000
Sr-90	0.04	150	7000
Cs-137	1	44	4600

[1] There are no limits established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other nuclides in Table 2 determine the waste to the Class C independent of these nuclides.

5. **Classification determined by both long- and short-lived radionuclides**. If radioactive waste contains a mixture of radionuclides, some of which are listed in Table 1, and some of which are listed in Table 2, classification shall be determined as follows:

   (a) If the concentration of a nuclide listed in Table 1 does not exceed 0.1 times the value listed in Table 1, the class shall be that determined by the concentration of nuclides listed in Table 2.

   (b) If the concentration of a nuclide listed in Table 1 exceeds 0.1 times the value listed in Table 1 but does not exceed the value in Table 1, the waste shall be Class C, provided the concentration of nuclides listed in Table 2 does not exceed the value shown in Column 3 of Table 2.

6. **Classification of wastes with radionuclides other than those listed in Tables 1 and 2**. If radioactive waste does not contain any nuclides listed in either Table 1 or 2, it is Class A.

7. **The sum of the fractions rule for mixtures of radionuclides.** For determining classification for waste that contains a mixture of radionuclides, it is necessary to determine the sum of fractions by dividing each nuclide's concentration by the appropriate limit and adding the resulting values. The appropriate limits must all be taken from the same column of the same table. The sum of the fractions for the column must be less than 1.0 if the waste class is to be determined by that column. Example: A waste contains Sr-90 in a concentration of 50 Ci/m^3. and Cs-137 in a concentration of 22 Ci/m^3. Since the concentrations both exceed the values in Column 1, Table 2, they must be compared to Column 2 values. For Sr-90 fraction 50/150=0.33; for Cs-137 fraction, 22/44=0.5; the sum of the fractions=0.83. Since the sum is less than 1.0, the waste is Class B.

8. **Determination of concentrations in wastes**. The concentration of a radionuclide may be determined by indirect methods such as use of scaling factors which relate the inferred concentration of one radionuclide to another that is measured, or radionuclide material accountability, if there is reasonable assurance that the indirect methods can be correlated with actual measurements. The concentration of a radionuclide may be averaged over the volume of the waste, or weight of the waste if the units are expressed as nanocuries per gram.

VI. Waste characteristics.

A. The following requirements are minimum requirements for all classes of waste and are intended to facilitate handling at the disposal site and provide protection of health and safety of personnel at the disposal site.

1. Waste must not be packaged for disposal in cardboard or fiberboard boxes.

2. Liquid waste must be solidified or packaged in sufficient absorbent material to absorb twice the volume of the liquid.

3. Solid waste containing liquid shall contain as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume.

4. Waste must not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.

5. Waste must not contain, or be capable of generating, quantities of toxic gases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste. This does not apply to radioactive gaseous waste packaged in accordance with paragraph A.7. of this section.

6. Waste must not be pyrophoric. Pyrophoric materials contained in waste shall be treated, prepared, and packaged to be nonflammable.

7. Waste in a gaseous form must be packaged at a pressure that does not exceed 1.5 atmospheres at 20ºC. Total activity must not exceed 100 curies per container.

8. Waste containing hazardous, biological, pathogenic, or infectious material must be treated to reduce to the maximum extent practicable the potential hazard from the non-radiological materials.

B. The requirements in this section are intended to provide stability of the waste. Stability is intended to ensure that the waste does not structurally degrade and affect overall stability of the site through slumping, collapse, or other failure of the disposal unit and thereby lead to water infiltration. Stability is also a factor in limiting exposure to an inadvertent intruder, since it provides a recognizable and nondispersible waste.

1. Waste must have structural stability. A structurally stable waste form will generally maintain its physical dimensions and its form, under the expected disposal conditions such as weight of overburden and compaction equipment, the presence of moisture, and microbial activity, and internal factors such as radiation effects and chemical changes. Structural stability can be provided by the waste form itself, processing the waste to a stable form, or placing the waste in a disposal container or structure that provides stability after disposal.

2. Notwithstanding the provisions in VI.A.2 and 3, liquid wastes, or wastes containing liquid, must be converted into a form that contains as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume of the waste when the waste is in a disposal container designed to ensure stability, or 0.5% of the volume of the waste for waste processed to a stable form.

3. Void spaces within the waste and between the waste and its package must be reduced to the extent practicable.

VII. Labeling. Each package of waste must be clearly labeled to identify whether it is Class A waste, Class B waste, or Class C waste, in accordance with section V of this appendix.

VIII. Maintenance of records, reports, and transfers.

A. Each licensee shall maintain any records and make any reports in connection with the licensed activities as may be required by the conditions of the license or by the rules, regulations, and orders of the Agency.

B. Records which are required by the regulations in this part or by license conditions must be maintained for a period specified by the appropriate regulations in this chapter or by license condition. If a retention period is not otherwise specified, these records must be maintained and transferred to the officials specified in paragraph E of this section as a condition of license termination unless the Agency otherwise authorizes their disposition.

C. Records which must be maintained pursuant to this part may be the original or a reproduced copy or a microform if this reproduced copy or microform is capable of producing copy that is clear and legible at the end of the required retention period. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records such as letters, drawings, specifications, must include all pertinent information such as stamps, initials, and signatures. The licensee shall maintain adequate safeguards against tampering with and loss of records.

D. If there is a conflict between the Agency's regulations in this part, license condition, or other written Agency approval or authorization pertaining to the retention period for the same type of record, the longest retention period specified takes precedence.

E. Notwithstanding paragraphs A through D of this section, the licensee shall record the location and the quantity of radioactive wastes contained in the disposal site and transfer these records upon license termination to the chief executive of the nearest municipality, the chief executive of the county in which the facility is located, the county zoning board or land development and planning agency, the State governor and other State, local, and Federal governmental agencies as designated by the Agency at the time of license termination.

F. Following receipt and acceptance of a shipment of radioactive waste, the licensee shall record the date of disposal of the waste, the location in the disposal site, the condition of the waste packages as received, any discrepancies between materials listed on the manifest and those received, and any evidence of leaking or damaged packages or radiation or contamination levels in excess of limits specified in Department of Transportation and Agency regulations. The licensee shall briefly describe any repackaging operations of any of the waste packages included in the shipment, plus any other information required by the Agency as a license condition. The licensee shall retain these records until the Agency transfers or terminates the license that authorizes the activities described in this section.

G. Each licensee shall comply with the safeguards reporting requirements of Part C of these regulations if the quantities or activities of materials received or transferred exceed the limits of these sections. Inventory reports required by these sections are not required for materials after disposal.

H. Each licensee authorized to dispose of radioactive waste received from other persons shall file a copy of its financial report or a certified financial statement annually with the Agency in order to update the information base for determining financial qualifications.

I. 1. Each licensee authorized to dispose of waste materials received from other persons, pursuant to this part, shall submit annual reports to the Agency. Reports must be submitted by the end of the first calendar quarter of each year for the preceding year.

2. The reports shall include:

   (a) specification of the quantity of each of the principal radionuclides released to unrestricted areas in liquid and in airborne effluents during the preceding year,

   (b) the results of the environmental monitoring program,

   (c) a summary of licensee disposal unit survey and maintenance activities,

   (d) a summary, by waste class, of activities and quantities of radionuclides disposed of,

   (e) any instances in which observed site characteristics were significantly different from those described in the application for a license; and

   (f) any other information the Agency may require. If the quantities of radioactive materials released during the reporting period, monitoring results, or maintenance performed are significantly different from those expected in the materials previously reviewed as part of the licensing action, the report must cover this specifically.

J. Each licensee shall report in accordance with the requirements of Part C.

K. Any transfer of radioactive materials by the licensee is subject to the requirements in Part C.

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APPENDIX E

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Appendix F

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APPENDIX G

SPECIAL REQUIREMENTS INVOLVING LOW-LEVEL RADIOACTIVE WASTE

1. Definitions

A. As used in this Part D Appendix G, the following definitions apply:

(1) **Activity** as it applies to reporting the radioactivity of waste requiring disposal refers to the radioactivity of the waste at the time of disposal. If the state did not have access to a disposal facility for that year, the radioactivity of waste placed in storage for that year shall apply (this radioactivity may be calculated to December 31 of the appropriate calendar year).

(2) **Generators of low-level radioactive waste** or **generators** means any persons who produce or process waste, as defined in part A, whether or not that waste is shipped off site.

(3) **Minimization plan** means the plan required of each licensee who generates waste requiring disposal, which identifies actions to allow for "storage for decay" of short-lived radioisotopes and actions to achieve source and volume minimization.

(3) **Mixed waste** means waste that also contain a hazardous component, regulated under subtitle C of the Resource Conservation and Recovery Act (RCRA).

(4) **Source minimization** means minimizing the volume and curie content of waste prior to its generation by such methods as: (1) avoiding unnecessary contamination of items during the use of radioactive materials; (2) carefully segregating waste from non-radioactive trash; (3) substituting non-radioactive isotopes or radioisotopes with shorter half-lives where practicable.

(5) **Storage** means the holding of waste for treatment or disposal.

(6) **Storage for decay** means a procedure in which waste that is authorized by the United States Nuclear Regulatory Commission to be stored at the site of generation for decay and ultimate disposal without regard to radioactivity.

(7) **Volume** as it applies to reporting volumes of waste requiring disposal refers to the required space for ultimate disposal at a waste disposal facility. If the state did not have access to a disposal facility for that year, the volume of waste to be disposed of that was placed in storage for that year shall apply.

(8) **Volume minimization** means treatment of waste after its generation in order to minimize the physical dimensions of the waste and the space required for disposal.

2. Low-Level Radioactive Waste Fund

A. An annual service fee and a compact fee assessment shall be billed by the agency. These fees are pro-rated such that fifty percent of the fees is based on volume of waste generated and fifty percent is based on the activity of waste generated.

B. Exempted from the annual service fee of Part D. Appendix G.2.A. are the following:

(1) Waste that is authorized by the United States Nuclear Regulatory Commission for disposal without regard to radioactivity;

(2) Waste that is stored for decay;

(3) Radioactive waste or other material that is returned to vendor, including, but not limited to, sealed sources.

C. The annual service fee and compact fee assessment, as specified in Part D. Appendix G.2.A, are determined by data collected on the Low-Level Radioactive Waste surveys. These fees will be based on a pro-rata share of the previous years' waste generation.

D. Generators are subject to service fee assessments the year following a termination of their radioactive materials license.

3. Annual Surveys of the Low-Level Radioactive Waste Stream

A. Generators of low-level radioactive waste must annually file a Low-Level Radioactive Waste Survey with the agency.

B. The Low-Level Radioactive Waste survey will require information concerning the volume, activity, isotopic content, chemical form, physical state, packaging, storage for decay, and interim storage capacity of waste and mixed wastes.

C. Completed survey forms must be returned to the agency within sixty days of the postmarked date.

D. Generators shall maintain copies of their survey forms for the preceding three calendar years.

4. Advance Notification of Transportation of Low-Level Radioactive Waste

A. The following reporting requirements are made in addition to the requirements of Parts D.38 and L.19.

B. Three working days prior to the transport of waste outside the confines of the generators' facility or other place of use or storage, or three working days prior to the delivery of any waste to a carrier for transport, each generator shall provide advance notification of such transport to the agency.

C. Advance notification is required only for:

(1) Waste that is being shipped to a disposal facility.

D. The notification required by Part D Appendix G.4.C. shall contain the following information:

(1) The name, address, and telephone number of the shipper, carrier and receiver of the shipment;

(2) A description of the waste contained in the shipment as required by the regulations of the U. S. Department of Transportation, 49 CFR 172.202 and 172.203;

(3) The point of origin of the shipment;

(4) The destination of the shipment and the 7-day period during which arrival of the shipment is estimated to occur;

(5) A point of contact with a telephone number for current shipment information

E. The notification required by Part D Appendix G.4. shall be made in writing to the agency. A notification delivered by mail must be postmarked 7 days prior to the date that the shipment is scheduled to occur. A notification delivered by telephone facsimile or messenger, must be delivered to the agency at least three working days prior to the date that the shipment is scheduled to occur. A copy of the notification shall be retained by the licensee for 1 year.

5. Waste Minimization

A. Generators who generate waste requiring disposal at a rate in excess of 100 cubic feet per calendar year, must submit a waste minimization plan to the agency on a biennial basis. The plan must include:

(1) A description of the facility and the process or service that generates the waste.

(2) Identification and characterization of the waste streams that result from the process or service.

(3) Analysis of the technical characterization of the waste stream to determine the practicability of source minimization and volume minimization.

(4) Declaration of goals for waste minimization efforts and an analysis of the successfulness of the current waste minimization effort.

B. A detailed existing waste minimization plan may be submitted for agency approval to meet the requirements of Part D Appendix G.5.A.

6. Packaging and Waste Form

A. Packaging and waste form of waste for disposal will comply with the requirements of the licensed or registered receiving Radioactive Waste Site or Authority.